RECLAMATION
Managing Water in the West

EXECUTION OF TWO WARREN ACT CONTRACTS TO WESTLANDS WATER DISTRICT AND WESTLANDS WATER DISTRICT DISTRIBUTION DISTRICT 1 TO FACILITATE A NON-CVP WATER TRANSFER FROM PLACER COUNTY WATER AGENCY

CENTRAL VALLEY PROJECT, CALIFORNIA
MID PACIFIC REGION
SOUTH-CENTRAL CALIFORNIA AREA OFFICE

ENVIRONMENTAL ASSESSMENT #EA-08-91

U.S. Department of the Interior
Bureau of Reclamation

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LIST OF ACRONYMS

AF	acre-feet
AFRP	Anadromous Fish Restoration Program
APE	Area of Potential Effects
BA	Biological Assessment
Bay-Delta	San Francisco Bay/Sacramento-San Joaquin Delta
BO	Biological Opinion
CALFED	CALFED Bay-Delta Program
CC	Coalinga Canal
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CESA	California Endangered Species Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
COA	Coordinated Operations Agreement
Corps	U.S. Army Corps of Engineers
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
D-1641	State Water Resources Control Board Decision 1641
D-893	State Water Resources Control Board Decision 893
Delta	Sacramento-San Joaquin Delta
DPC	Delta Protection Commission
DOI	Department of Interior
DWR	Department of Water Resources
EA	Environmental Assessment
EC	Economic Criterion
EFH	essential fish habitat
E/I	export/import
EID	El Dorado Irrigation District
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERPP	Ecosystem Restoration Program Plan
ESA	Federal Endangered Species Act of 1973, as amended
ESU	Evolutionarily Significant Unit
EWA	Environmental Water Account
FERC	Federal Energy Regulatory Commission
FONSI	finding of no significant impact
GWh	gigawatt hours
I-5	Interstate 5
IEP	Interagency Ecological Program
ITA	Indian Trust Asset
JPOD	Joint Point of Operation
M&I	municipal and industrial

MFP	Middle Fork Project
MSCS	Multi-Species Conservation Strategy
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
MW	megawatts
MWh	megawatt hours
NCCPA	Natural Community Conservation Planning Act
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuges
OCAP	Operations Criteria and Plan
OEHHA	Office of Environmental Health Hazard Assessment
Parkway	American River Parkway
PCWA	Placer County Water Agency
PG&E	Pacific Gas and Electric Company
PL	public law
PWCA	Placer County Water Agency
Reclamation	U.S. Bureau of Reclamation
RM	river mile
ROD	Record of Decision
RWA	Regional Water Authority
SLC	San Luis Canal
SRA	State Recreation Area
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total dissolved substances
TOC	Total organic carbon
USFWS	U.S. Fish and Wildlife Service
VELB	Valley Elderberry Longhorn Beetle
WA	Warren Act
Western	Western Area Power Administration
WWD	Westlands Water District
WWDD1	Westlands Water District Distribution District No. 1
WMA	Wildlife Management Area
WQCP	Bay Delta Water Quality Control Plan
X2	2 ppt salinity isopleth

Execution of Two Warren Act Contracts to Westlands Water District and Westlands Water District Distribution District 1 to Facilitate a Non-CVP Water Transfer from Placer County Water Agency

Environmental Assessment

1.0 Introduction

Temporary water transfers have been advocated as a critically important mechanism to distribute water throughout California. For example, in its August 28, 2000 Record of Decision (ROD) for the CALFED Bay-Delta Program (CALFED) Final Programmatic Environmental Impact Statement/Environmental Impact Report, water transfers were identified as a key component of a long-term comprehensive plan to restore the ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) estuary system. Placer County Water Agency (PCWA) has implemented several temporary water transfers over the past 25 years to enhance water supply, water quality, and environmental conditions.

Water transfers have become an important component in Westlands Water District (WWD) water supply. Transfers from other districts are pursued each year to supplement reduced contract deliveries when the price is reasonable. Transfers within WWD are used to supplement a water user's allocation from supplies currently available.

In the San Joaquin Valley, one of the nation's most productive agricultural areas, the dry conditions have increased crops' water demands, yet made the needed water supplies even scarcer. WWD provides water supply to over 600,000 acres of valuable and productive farmland within Fresno and Kings Counties. WWD's long-term source of water supply is the Central Valley Project (CVP), operated by Reclamation. Reclamation's 2008 allocation to WWD was initially 45 percent of WWD's contract amount, but was subsequently reduced to 40 percent after significant agricultural investments were made. Furthermore, dry conditions and operational constraints limited CVP deliveries to WWD during a crucial part of the growing season this past summer. Given very low State-wide reservoir storages entering into this coming water year, Central Valley growers are experiencing another year of reduced allocations.

In recognition of the severe impacts of the water shortage caused by general drought conditions and reduced CVP deliveries to WWD and other agricultural districts within Fresno County, the Fresno County Board of Supervisors passed Resolution No. 08-253 on June 6, 2008. Resolution No. 08-253 declared a local state of emergency in Fresno County due to severe drought conditions, which had local water districts ration water supplies. This resolution indicated that thousands of acres of crops were being abandoned, and that these crop losses would result in job losses and other economic impacts in Fresno County communities, which would also affect Fresno County businesses and local tax revenues. On

July 29, 2008, the Kings County Board of Supervisors also readopted a resolution declaring emergency drought conditions.

On June 4, 2008, Governor Arnold Schwarzenegger issued Executive Order S-06-08, which proclaimed a condition of Statewide drought. In this Executive Order, the Governor ordered the California Department of Water Resources (DWR) to "[f]acilitate water transfers in 2008 to timely respond to potential emergency water shortages…" Subsequent to issuing Executive Order S-06-08, the Governor, on June 12, 2008, proclaimed a state of emergency in Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern Counties. In this proclamation, the Governor ordered that the State Water Resources Control Board (SWRCB) "shall expedite the processing and consideration of water rights urgency change petitions filed by DWR and other agencies to facilitate water transfers to the San Joaquin Valley." Importantly, the Governor also ordered "that the emergency exemptions in sections 21080(b)(3) and 21172 of the Public Resources Code shall apply to all activities and projects ordered and directed under this proclamation, to the fullest extent allowed by law."

Government Code Section 8558 defined a "state of emergency" as "conditions of disaster of extreme peril to the safety of persons and property within the State caused by such conditions as …drought." Just such conditions exist within the WWD service area, and property will be lost at great economic and social cost to the State unless mitigated through water transfers such as that proposed here.

In response to the dry conditions and to move water to an area of high need, PCWA is proposing a temporary water transfer of 20,000 acre-feet (AF) of its 2008 water supplies currently stored in its Middle Fork Project (MFP) reservoirs on the Rubicon and American Rivers to WWD for irrigation use within the WWD service areas. To facilitate the transfer, the U.S. Bureau of Reclamation (Reclamation) proposes to execute two Warren Act (WA) contracts for a total of 20,000 AF of PCWA water to be stored and conveyed through Federal facilities.

1.1 Statement of Purpose and Need

Due to water shortages, WWD and Westlands Water District Distribution District No. 1 (WWDD1) do not have sufficient water to meet the current demands within their service areas. This Proposed Action is intended to help alleviate water supply shortages within WWD and WWDD1 exacerbated by the drought.

WWD and WWDD1 face deficits in their water supplies in 2008, and similar conditions are envisioned for 2009. The result of this shortfall has been and will be the loss of agricultural crops and potential damage to perennial crops. The potential loss of permanent crops such as orchards or vineyards represents a disruption because such crops require years of investment and planning, making their loss effectively irreparable. This transfer would prevent some of the potential damage from the drought emergency this year.

Reclamation's purpose of executing the two WA contracts is to allow WWD and WWDD1 to convey and temporarily store up to 20,000 AF of non-CVP water obtained from PCWA using Federal facilities.

1.2 Purpose of this Environmental Assessment

This document meets Reclamation's impact assessment obligations under the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.). NEPA requires full disclosure regarding potential Federal actions, their alternatives, potential impacts, and possible mitigation for actions taken by Federal agencies.

This document, therefore, will serve as the appropriate environmental review and approval document under the NEPA, consisting of an Environmental Assessment (EA) and finding of no significant impact (FONSI). Reclamation is the designated lead agency under NEPA.

1.3 Warren Act Contract

The WA (43 U.S.C. §523) of 1911 provides authorization to the Secretary of the Interior to enter into WA contracts with water purveyors to carry non-CVP water (i.e., water not developed as part of the CVP) through Federal facilities. Under Section 305 of the States Emergency Drought Relief Act of 1991 (43 U.S.C. §2211 et seq.), "Excess Storage and Carrying Capacity," the Secretary is authorized to execute contracts with municipalities, public water districts and agencies, other Federal agencies, State agencies, and private entities pursuant to the WA. These contracts provide for the impounding, storage, and conveyance of non-CVP water for domestic, municipal, fish and wildlife, industrial, and other beneficial uses using any CVP facilities identified in the law, including Shasta Reservoir, Folsom Reservoir, Jones Pumping Plant, the Delta-Mendota Canal, San Luis Reservoir, O'Neill Forebay, and the San Luis Canal.

1.4 Project Agencies and Related Facilities

1.4.1 Placer County Water Agency

PCWA was formed in 1957 for the purpose of developing and operating major water facilities in Placer County. PCWA developed and Pacific Gas and Electric Company (PG&E) currently operates the MFP (**Figure 1-1**). The MFP is a multi-purpose project designed to conserve and control waters of the Middle Fork American River, the Rubicon River, and certain tributaries for irrigation, domestic and commercial purposes, and for the generation of electric energy. Principal features include two storage reservoirs and five diversion dams, five power plants, diversion and water transmission facilities, five tunnels, and related facilities. The power plants have a combined dependable generating capacity of 190,700 kilowatts. The two storage reservoirs, Hell Hole and French Meadows, have a combined capacity of 340,000 AF.

The MFP, developed and owned by PCWA, regulates flows along the Middle Fork American River. PCWA has direct diversion rights from the North Fork American River and two primary diversions: one near the proposed Auburn Dam site and one from Folsom Reservoir. Flows not diverted from the upper American River tributaries are realized as Folsom Reservoir inflow. Folsom Reservoir is located at the confluence of the North Fork and South Fork of the American Rivers, north of the City of Folsom, and is the uppermost boundary of the lower American River.

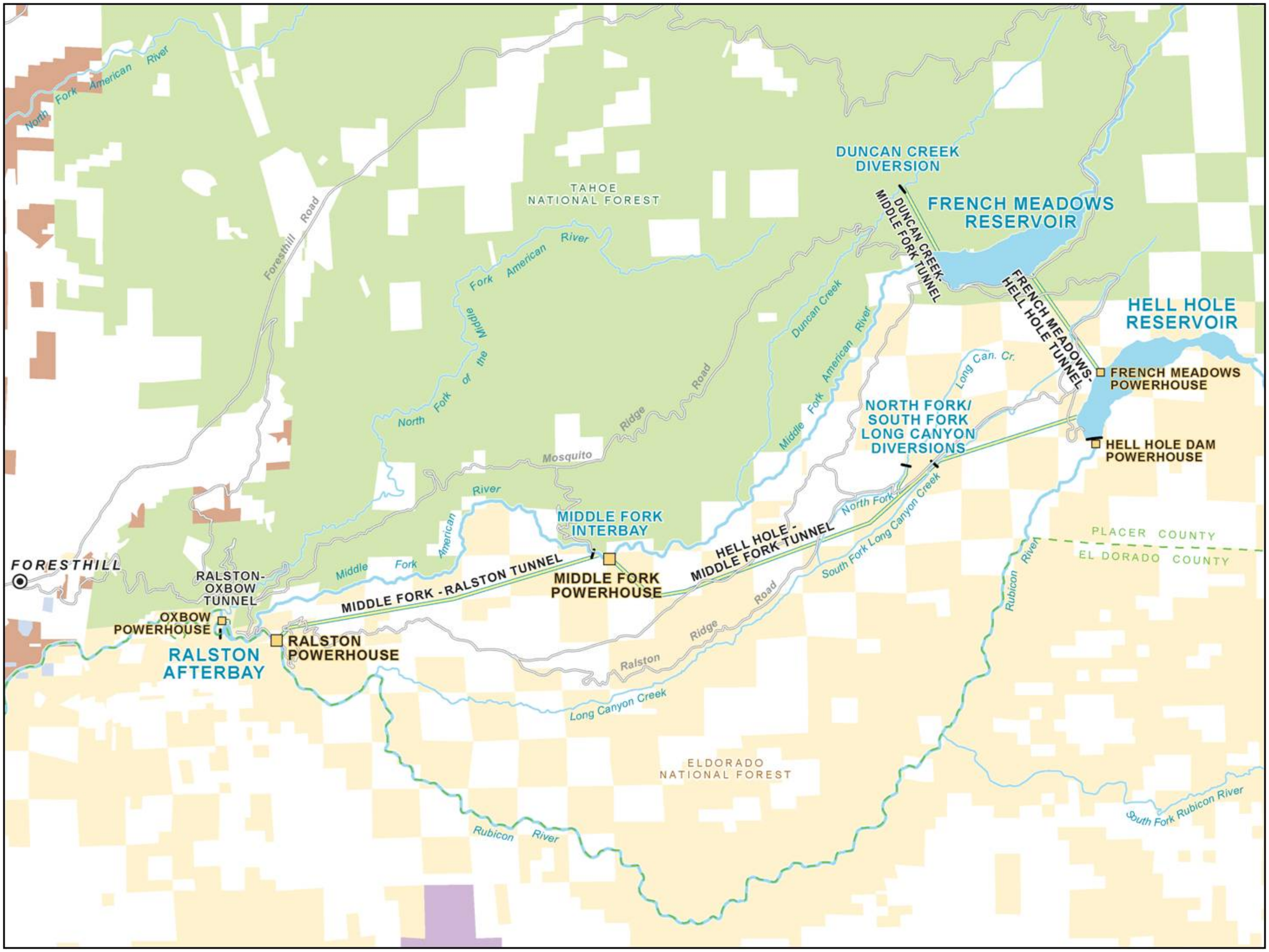

Figure 1-1. Middle Fork Project

1.4.2 Westlands Water District and Westlands Water District Distribution District No. 1

WWD was formed in 1952, encompassing more than 600,000 acres of farmland in western Fresno and Kings Counties, and serves approximately 600 family-owned farms that average 900 acres in size (**Figure 1-2**). WWD is located in the San Luis Unit of the CVP. The main water supply features that serve the San Luis Unit are the San Luis Dam and Reservoir, the San Luis Canal (SLC), and the Coalinga Canal (CC). Once the water leaves the CVP canals, water is delivered to farmers through 1,034 miles of underground pipe and more than 3,300 water meters.

WWDD1 includes roughly 200,000 acres. It is a separate entity and can enter into contracts or other obligations separate from WWD itself.[1] It was formed several years ago to hold assigned water service contracts as part of the Sagouspe Settlement, but has also undertaken other activities. It has the legal power to enter into WA contracts and take other actions not taken by WWD itself.

WWD's permanent distribution system consists of a closed, buried pipeline network designed to convey irrigation water to 160- or 320-acre land units from the SLC, the CC, and a 7.4- mile unlined canal from the Mendota Pool. The distribution system was built between 1965 and 1979. The area served by the completed system serves approximately 88 percent of the irrigable land in the WWD, including all land lying east of the SLC.

1.4.3 Central Valley Project

The CVP, initially authorized by Congress in the 1935 Rivers and Harbors Act, is a multi-purpose project operated and maintained by Reclamation that stores and transfers water from the Sacramento, San Joaquin, and Trinity River basins to the Sacramento and San Joaquin valleys (**Figure 1-3**). The CVP reaches from the Cascade Mountains near Redding in the north some 500 miles to the Tehachapi Mountains near Bakersfield in the south. Designs for the CVP were motivated by a fear of floods and drought, and a desire to transport water from the northern end of the Central Valley to the drier southern end. The CVP was authorized for water supply, hydropower generation, flood control, navigation, fish and wildlife, recreation, and water quality control purposes.

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[1] A distribution district, like an improvement district, can be formed by a water district. It is a separate entity capable of acting independent of the larger water district, although the board of the distribution district is the board of the overall district. All land within a distribution district is by definition also within the larger water district. A distribution district can impose charges on the lands within the distribution district that are not imposed on other land within the "parent" water district. Distribution districts and improvement districts are generally formed when a significant project will benefit large areas within a water district, but not all land in the water district. Distribution districts and improvements districts are vehicles to fund such projects that impose charges only on the benefited lands. One example would be if several landowners wanted to build a new lateral to service their lands; the water district might form a distribution district or improvement district including just those lands benefited by the new lateral so assessments or other charges could be imposed on just those lands to pay for the pipeline benefiting those lands. Lands in a distribution district remain responsible for general water district charges.

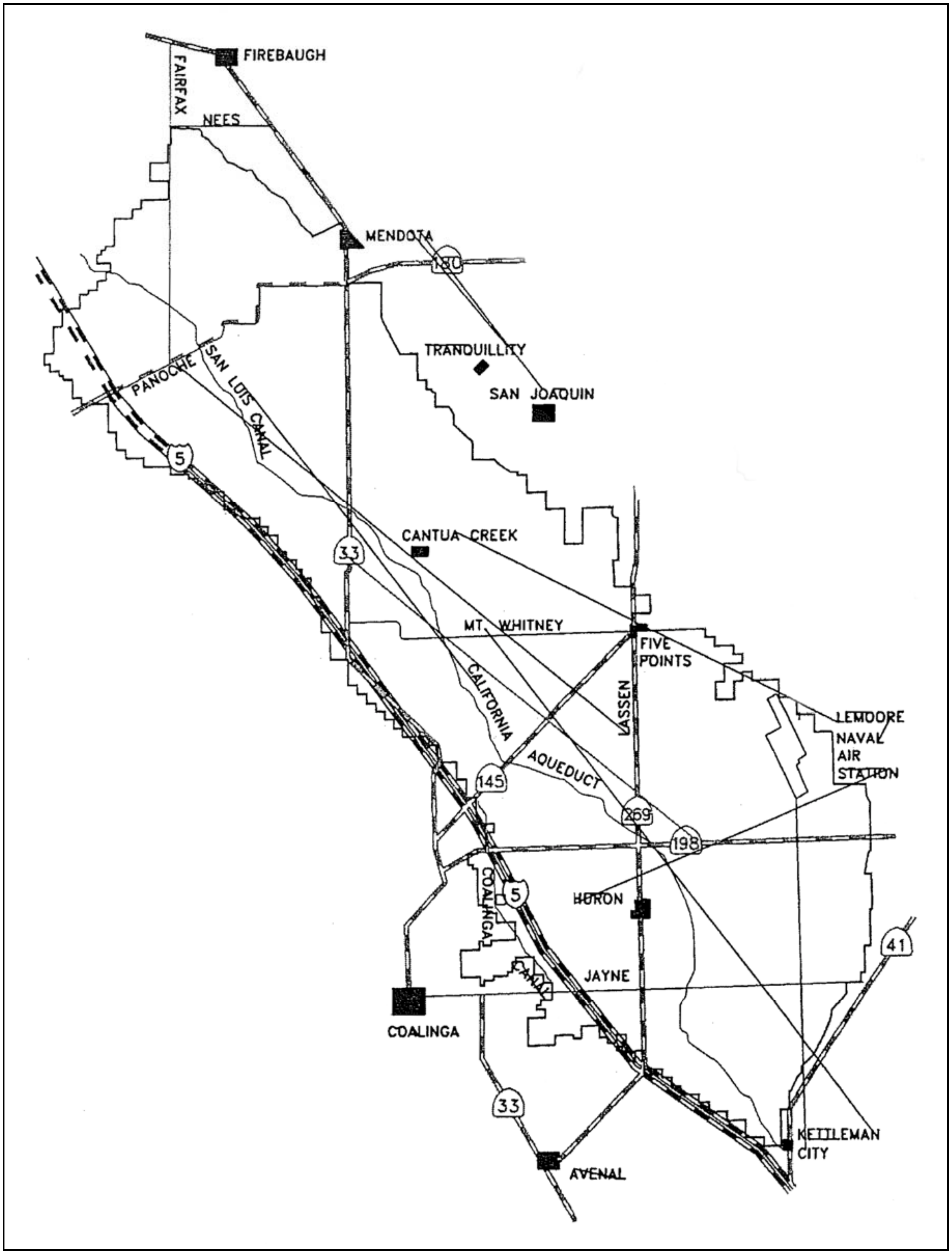

Figure 1-2. Westlands Water District

Figure 1-3. CVP Facilities

CVP facilities include 18 dams and reservoirs, 39 pumping plants, 2 pumping-generating plants, 11 power plants and 500 miles of major canals as well as conduits, tunnels, and related facilities. Today these CVP facilities annually deliver approximately 7 million AF of water and supplies irrigation water to the Sacramento and San Joaquin Valleys, water to cities and industries in Sacramento and the east and south Bay Areas, and to fish hatcheries and wildlife refuges throughout the Central Valley.

Folsom Dam and Reservoir

Originally authorized in 1944 as a 355,000 AF flood control unit, Folsom Dam was reauthorized in 1949 as a 1,000,000 AF multiple-purpose facility. The U.S. Army Corps of Engineers (Corps) constructed Folsom Dam and transferred it to Reclamation for coordinated operation as an integral part of the CVP. Reclamation operates Folsom Dam and Reservoir for the purposes of flood control, meeting water contract obligations, providing instream flows in the lower American River for recreation and fisheries resources, and as a means of meeting Sacramento-San Joaquin Delta (Delta) water quality standards.

Lake Natoma and Nimbus Dam

Lake Natoma serves as the Folsom Dam afterbay and was formed as a result of Nimbus Dam. Lake Natoma has a maximum storage capacity of 9,000 AF, and inundates approximately 500 acres. Lake Natoma is operated as a re-regulating reservoir that accommodates the diurnal flow fluctuations caused by the power peaking operations at Folsom Power Plant. Nimbus Dam, along with Folsom Dam, regulates water releases to the lower American River.

Jones Pumping Plant

Reclamation completed the Jones Pumping Plant in 1951 as part of the CVP. The CVP operates the Jones Pumping Plant to lift water from the Southern Delta into the Delta-Mendota Canal to service CVP contractors in the San Joaquin Valley and the Tulare Basin. The Jones Pumping Plant facilities include an inlet channel, pumping plant, and discharge pipes. The pumping plant lifts water 197 feet from the Delta into the Delta-Mendota Canal. Each of the six pumps at Jones Pumping Plant is powered by a 22,500 horsepower motor and is capable of pumping 850 to 1100 cubic feet per second (cfs). CVP power plants supply power to run the pumps. The water is pumped through three 15-foot diameter discharge pipes and carried about one mile up to the Delta-Mendota Canal. The intake canal includes the Tracy Fish Facility, which was built to intercept downstream migrant fish so they may be returned to the main channel.

Delta-Mendota Canal

The Delta-Mendota Canal is the main conveyance facility of the CVP. It conveys water from the Jones Pumping Plant in the southern Delta to agricultural lands in the San Joaquin Valley. Water not delivered directly is diverted from the Delta-Mendota Canal at O'Neill Pumping Plant into O'Neill Forebay. The water then either flows along the San Luis Canal to CVP contractors in the San Joaquin Valley or is lifted into San Luis Reservoir through Gianelli Pumping/Generating Plant for later use. The majority of the stored water is used in the southern Central Valley, with some water being diverted to Santa Clara and Benito counties.

San Luis Reservoir

San Luis Reservoir is an offstream storage reservoir jointly operated by the CVP and the State Water Project (SWP). The reservoir, located near Los Banos, has a capacity of 2,041,000 AF, and stores exports from the Delta to be used when the water is needed in the Export Service Area. Both the CVP and SWP systems use San Luis Reservoir to increase water allocations. San Luis Reservoir water supplements other CVP or SWP water during periods of constrained operations in the Delta and when demands exceed maximum capacity at the pumping plants.

San Luis Canal

This joint CVP/SWP facility is a concrete-lined canal with a capacity ranging from 8,350 to 10,300 cfs. The San Luis Canal is the Federally-built section of the California Aqueduct, although DWR operates and maintains the San Luis Canal The canal extends 102.5 miles from the O'Neill Forebay, near Los Banos, in a southeasterly direction to a point west of Kettleman City. The 138-foot-wide channel is 36 feet deep, 40 feet wide at the bottom, and lined with concrete.

Coalinga Canal

This Federal facility, formerly called Pleasant Valley Canal, carries water from the turnout structure on the San Luis Canal to the Coalinga area, in Fresno County. The 12-mile concrete-lined system includes a 1.6-mile intake channel to the Pleasant Valley Pumping Plant and 11.6 miles of canal. The initial capacity of the canal is 1,100 cfs, decreasing to 425 cfs at the terminus. Reaches 1 and 2 of the canal are operated by the WWD.

2.0 Description of Proposed Action and Alternatives

2.1 No Action Alternative

Under the No Action Alternative, Reclamation would not enter into two concurrent one-year WA contracts with WWD and WWDD1. Therefore, WWD and WWDD1 would not receive 10,000 AF of PCWA transfer water, respectively. As a result, there would be no change to instream flow releases in the Middle Fork and North Fork American River, lower American River, Sacramento River, and the Delta.

2.2 Proposed Action Alternative

Reclamation proposes to enter into two concurrent one-year WA contracts, for Federal conveyance and storage of up to 10,000 AF of water from PCWA with both WWDD1 and WWD for a total of 20,000 AF of non-CVP water to be stored and conveyed through Federal facilities. Federal facilities potentially involved in the conveyance and storage include Folsom Reservoir, Jones Pumping Plant, and San Luis Reservoir (Figure 1-3).

A petition for the proposed temporary water transfer facilitated by the WA contracts was filed on August 5, 2008 on behalf of PCWA with the SWRCB under Permits 18085 and 18087. The petition requests a change in the “Point of Diversion” and “Place of Use.” The point of diversion is proposed to be Jones Pumping Plant, part of the CVP. The place of use is modified from the PCWA service area in Western Placer County to the WWD service area (which encompasses WWDD1) in Fresno and Kings Counties, California. No change in the purpose of use is anticipated with the proposed water transfer.

Under the proposed transfer, PWCA would release water from its MFP reservoirs into the Middle Fork American River, which subsequently flows into the North Fork American River, during November and December 2008. From the North Fork American River, the released water would flow into Folsom Reservoir. Through WA contracts with WWD and WWDD1, Reclamation would release water from Folsom Reservoir into the lower American River, the Sacramento River, and through the Delta to Jones Pumping Plant. From Jones Pumping Plant, water would be conveyed through the Delta-Mendota Canal and pumped into O’Neill Forebay where it would be diverted either for immediate WWD and WWDD1 use or for storage in San Luis Reservoir for later release to the San Luis and Coalinga canals for WWD and WWDD1 use.

The 20,000 AF proposed to be released for transfer to WWD and WWDD1 is currently in MFP storage and would not be released in the absence of this transfer. Reclamation has agreed that the release of this water from storage is “new water” that would not otherwise would be available to WWD and WWDD1.

In order to refill MFP reservoirs, without injury to downstream vested water rights holders following the transfer, PWCA would enter into a refill agreement with Reclamation, similar to refill agreements that PWCA and Reclamation have entered into on other PWCA transfers.

The Proposed Action would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and redivert water. Land uses within the PCWA and WWD service areas would not change as a result of the transfer.

2.2.1 Project Operations

The plan for transferring 20,000 AF of water from PCWA to WWD and WWDD1 is to release water during November through December 2008 from MFP reservoirs into the Middle Fork and North Fork American Rivers, via a series of tunnels, the Middle Fork Interbay Diversion Dam, and several powerhouses into the Oxbow Reservoir (Ralston Afterbay). The water would be released from Oxbow Reservoir into the Middle Fork American River below the Oxbow Powerhouse, where it would flow down the Middle Fork American River into the North Fork American River and subsequently into Folsom Reservoir.

The water would be released from Folsom Reservoir into Lake Natoma, which is impounded by Nimbus Dam. Lake Natoma serves as the re-regulating afterbay for Folsom Reservoir. The water would be released at a steady rate from November 10 through December 15, 2008, from Nimbus Dam into the lower American River, and subsequently would flow into the Sacramento River and the Delta. The transfer water would be conveyed from the Jones Pumping Plant in the southern portion of the Delta into CVP conveyance channels, and either stored in San Luis Reservoir or transported to WWD and WWDD1 via San Luis and Coalinga canals for immediate use.

Under the Proposed Action, the time period associated with releases from the MFP reservoirs overlaps with the time period for releases from Folsom Reservoir. MFP releases may end later than releases from Folsom Reservoir. In this case, Reclamation would operate Folsom Reservoir to accommodate any difference between the timing of inflow and release of the 20,000 AF of transfer water, consistent with WA contract authorities and provisions.

The release of transfer water from Nimbus Dam would end on December 15, 2008. A total of 20,000 AF would be released from the MFP reservoirs. This quantity equates to a steady release of 280 cfs from Nimbus Dam for 36 days. The Proposed Action calls for an increased release from Nimbus Dam of 100 cfs from November 10 through December 15, 2008. Flows from Keswick Dam into the Sacramento River would be reduced by approximately 100 cfs during the same period.

Although Nimbus Dam releases would only increase 100 cfs over the No Action Alternative forecasted release of 1,000 cfs, 280 cfs would be considered as non-CVP water released from Folsom Reservoir storage, resulting in an increase of CVP storage at Folsom Reservoir of 12,859 AF. The 100 cfs reduction from Keswick Dam releases would result in an increase of 7,141 AF of CVP water in Shasta Reservoir storage for future CVP project use relative to the No Action Alternative.

A portion of the 20,000 AF of transfer water would be consumed as Delta carriage water[1], with the balance being pumped at Jones Pumping Plant and conveyed to San Luis Reservoir for immediate use in the WWD and WWDD1 service areas, or for storage in San Luis Reservoir and subsequent conveyance for later use as may be determined by WWD, WWDD1, and Reclamation. The Proposed Action would not result in an increase in Delta pumping during the proposed action.

The net result in CVP storage at the conclusion of the Proposed Action would be the following:

- Folsom Reservoir storage would increase by 12,859 AF of CVP water;
- Shasta Reservoir storage would increase by 7,141 AF of CVP water; and
- Overall San Luis Reservoir storage would not change relative to the No Action Alternative.

Water that is released for use by WWD and WWDD1 would be in addition to other releases to the Middle Fork American River and subject to the existing PCWA obligations for its customers. The minimum instream flow requirement for the Middle Fork American River is based on the Federal Energy Regulatory Commission (FERC) license requirements for the MFP. Flow below Ralston Afterbay is measured downstream of the confluence of the Middle Fork American River and the North Fork of the Middle Fork American River below the Oxbow Powerhouse.

Implementation of the Proposed Action would continue to meet Reclamation's regulatory obligations including Delta standards and instream flow requirements on the lower American and Sacramento rivers. These obligations include the biological opinion (BO) for winter-run and spring-run Chinook salmon and Central Valley steelhead, the BO for delta smelt, water rights permit terms and conditions, SWRCB decisions, and other operational constraints (e.g., Wilkins Slough navigation control point).

2.2.2 Action Area

The Action Area includes the areas where the direct and indirect effects of the proposed water transfer could occur for the resource areas discussed in Chapter 3.0, Affected Environment. The man-made and natural water storage and conveyance systems that could be affected by the proposed water transfer facilitated by the WA contract executions would occur in California, from Placer and Shasta counties and the Sierra foothills to the Delta, southern San Joaquin Valley, as well as in Fresno and King Counties in the Central Valley. The Action Area also encompasses the service areas of PCWA, WWD, and WWDD1. Chapter 3 describes the relevant natural features and facilities in these general areas in detail.

[1] Carriage water losses are typically about 20 percent. However, the actual volume of carriage water loss would be determined after the water is pumped in the Delta. Carriage water losses would be borne by WWD and WWDD1. Water deliveries to WWD and WWDD1 are expected to total between 16,000 AF and 18,000 AF due to carriage losses through the Delta.

2.3 Summer 2009 Action Alternative

The environmental review process under NEPA requires that all reasonable alternatives to the Proposed Action that meet the purpose and need be examined. Those alternatives determined to be unreasonable are eliminated from further consideration. In addition to the Proposed Action, the Summer 2009 Action Alternative was identified:

Under this alternative, Reclamation would execute two concurrent one-year WA contracts with WWD and WWDD1 in the Proposed Action above. PWCA would release 20,000 AF of water from MFP reservoirs during November and December 2008, which would be stored in Folsom Reservoir for later transfer to WWD and WWDD1 during July and August 2009. The transfer water would be conveyed through Federal facilities. Federal facilities potentially involved in the conveyance and storage include Folsom Reservoir, Jones Pumping Plant (or Banks Pumping Plant consistent with Joint Point of Diversion [JPOD]), and San Luis Reservoir. Transfer water stored in Folsom Reservoir would be subject to spill from the reservoir if it becomes necessary to evacuate water from Folsom Reservoir for flood control purposes. Water spilled from Folsom Reservoir would be considered lost and not available for use by WWD and WWDD1.

Under the Summer 2009 Action Alternative, PWCA would release transfer water from its MFP reservoirs into the Middle Fork American River, which subsequently flows into the North Fork American River, during November and December 2008. From the North Fork American River, the released water would flow into Folsom Reservoir. Through WA contracts with WWD and WWDD1, Reclamation would release water from Folsom Reservoir into the lower American River, the Sacramento River, and through the Delta to Jones and Banks pumping plants during July and August 2009. From the pumping plants, water would be conveyed to San Luis Reservoir where it would be diverted either for immediate WWD and WWDD1 use or for storage in San Luis Reservoir for later WWD and WWDD1 use.

The 20,000 AF proposed to be released for transfer to WWD and WWDD1 is currently in MFP storage and would not be released in the absence of this transfer. Reclamation has agreed that the release of this water from storage is “new water” that would not otherwise would be available to WWD and WWDD1.

In order to refill MFP reservoirs, without injury to downstream vested water rights holders following the transfer, PWCA has entered into a refill agreement with Reclamation, similar to refill agreements that PWCA and Reclamation have entered into on other PWCA transfers.

The Summer 2009 Action Alternative would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and redivert water. Land uses within the PCWA and WWD service areas would not change as a result of the transfer.

2.3.1 Project Operations

Under the Summer 2009 Action Alternative, the 20,000 AF water transfer would occur during November through December 2008 and would be identical to that of the Proposed Action described above. The transfer water would be released during July and August 2009, from Nimbus Dam into the lower American River, and subsequently would flow into the

Sacramento River and the Delta. The transfer water would be conveyed from the Jones or Banks pumping plant in the southern portion of the Delta into conveyance channels, and transported to WWD and WWDD1 via San Luis and Coalinga canals for immediate use.

The end of December 2008 Folsom Reservoir storage for the Summer 2009 Action Alternative would be 20,000 AF greater than the No Action Alternative. At the conclusion of the July and August 2009 water transfer, Folsom Reservoir storage would equal that of the No Action Alternative.

The Summer 2009 Action Alternative would increase the release from Nimbus Dam by 163 cfs for July and August, 2009. Flows from Keswick Dam into the Sacramento River to the confluence with the lower American River would be the same as those under the No Action Alternative. In the Sacramento River below the confluence with the lower American River, flows would increase by 163 cfs during July and August 2009 relative to the No Action Alternative.

A portion of the 20,000 AF of transfer water would be consumed as Delta carriage water, with the balance being pumped at Jones or Banks pumping plant and conveyed to San Luis Reservoir for immediate use in the WWD and WWDD1 service areas, or for storage in San Luis Reservoir and subsequent conveyance for later use as may be determined by WWD, WWDD1, and Reclamation. The Summer 2009 Action Alternative would result in an increase in Delta pumping during July and August 2009.

The net result in CVP storage at the conclusion of Summer 2009 Action Alternative (August 2009) would be the following:

- Folsom Reservoir storage would return to same storage level as the No Action Alternative;
- Shasta Reservoir storage would not change relative to the No Action Alternative; and
- San Luis Reservoir storage would not change relative to the No Action Alternative.

Obligations associated with the water released for use by WWD and WWDD1 would be identical to that in the Proposed Action Alternative described above.

2.3.2 Action Area

The Action Area includes the areas where the direct and indirect effects of the proposed water transfer could occur for the resource areas discussed in Chapter 3.0, Affected Environment. The man-made and natural water storage and conveyance systems that could be affected by the proposed water transfer facilitated by the WA contract executions would occur in California, from Placer County and the Sierra foothills to the Delta, southern San Joaquin Valley, as well as in Fresno and King counties in the Central Valley. The Action Area also encompasses the service areas of PCWA, WWD, and WWDD1. Chapter 3, Affected Environment, describes the relevant natural features and facilities in these general areas in detail.

3.0 Affected Environment

3.1 Introduction

This chapter describes the environmental resources in the Action Area that may be affected by implementation of the action alternatives. These descriptions provide the necessary background information for each resource from which to analyze the potential effects of the project, as described in Chapter 4, Environmental Consequences. The action alternatives have the potential to affect water-related resources (e.g., fisheries and aquatic resources, water supply and hydrology, etc.) as a result of changes in reservoir releases, instream flows, and water temperatures, as well as changes to the existing water supply system. Other resources (e.g., terrestrial resources) have the potential to be affected through secondary indirect effects associated with delivery of MFP water.

This chapter describes the affected environment for the following resources:

- Water Supply and Hydrology
- Surface Water Quality
- Hydropower
- Fisheries and Aquatic Resources
- Terrestrial and Riparian Resources
- Recreation
- Cultural Resources
- Indian Trust Assets
- Environmental Justice
- Land Use
- Socioeconomics

During preparation of the EA it became evident that the Proposed Action would have no effect on several resources within the Action Area, because the Proposed Action: (1) does not include any construction-related activities; and (2) would not directly result in land conversions. Therefore, no affected environment description has been provided in this chapter and no impact analysis has been conducted in Chapter 4, Environmental Consequences, related to potential effects on air quality, noise, geology and soils, visual resources, transportation, public utilities, or public services.

Because the Proposed Action does involve Reclamation’s operation of CVP facilities for water supply and other environmental or regulatory obligations, the Action Area does include many of the reservoirs and watercourses of the CVP, north of and including the Delta, and CVP Export Service Area.

3.2 Water Supply, Hydrology, and Flows

This section describes aspects of the affected environment relating to the water supply and management of surface water that may be affected if the action alternatives are implemented.

3.2.1 Environmental Setting

Middle Fork and North Fork American Rivers

The American River is a major tributary to the lower Sacramento River. The headwaters for the Middle Fork American River watershed (i.e., the Rubicon River) are at Rockbound Valley in the Desolation Wilderness (elevation 9,974 feet). The Middle Fork American River watershed extends westward to the confluence with the North Fork American River, east of

Auburn (elevation 650 feet). The average annual yield for the Middle Fork American River for the period of 1959 through 1991 was 805,000 AF. The Rubicon River is the main tributary to the Middle Fork American River, and receives its water from the South Fork Rubicon River and Pilot Creek. Other tributaries to the Middle Fork American River are Duncan Canyon Creek, and Long Canyon Creek. The main reservoirs in the Middle Fork watershed are French Meadows, Hell Hole, Rubicon, Loon Lake, Gerle Creek, and Stumpy Meadows Lake. PCWA and PG&E operate most of the reservoirs in the Middle Fork watershed.

PCWA developed and PG&E currently operates the MFP, a multi-purpose project designed to conserve and control waters of the Middle Fork American River, the Rubicon River, and certain tributaries for irrigation, domestic, and commercial purposes, and for the generation of electricity. French Meadows and Hell Hole reservoirs are the primary storage facilities, but the MFP also includes five diversion dams, five power plants, diversion and water transmission facilities, five tunnels, and related facilities. Water that is not diverted to storage travels through a system of tunnels and power plants before being released into the Middle Fork American River.

Water from French Meadows and Hell Hole reservoirs is released downstream to Ralston Afterbay on the Middle Fork American River. Ralston Afterbay, located approximately 20 miles east of Auburn, is operated as a re-regulating reservoir for the MFP. Ralston Afterbay releases reflect upstream regulation to maximize hydropower generation while meeting an instream flow requirement of 75 cfs on the Middle Fork American River. The Middle Fork then joins the North Fork American River before flowing into Folsom Reservoir. PCWA has water rights allowing for power generation and recreational uses, as well as for irrigation and incidental domestic and municipal and industrial (M&I) uses. PCWA's water rights authorize 120,000 AF of consumptive uses of the combined waters of the North and Middle Fork American rivers.

The headwaters to the North Fork American River watershed are in the Sierra Nevada at an elevation of approximately 9,000 feet. The watershed extends westerly to Folsom Reservoir, south of Auburn, at the 650-foot elevation. The North Fork flows are altered by the North Fork Dam at Lake Clementine, upstream of its confluence with the Middle Fork American River.

Downstream of its confluence with the Middle Fork American River, the North Fork American River flows are a combination of regulated and unregulated flows. Flows in the North Fork below its confluence with the Middle Fork are directly affected by fluctuations in Ralston Afterbay releases, but are attenuated by the unregulated flows from the North Fork of the Middle Fork American River and the North Fork American River, which exhibit less diurnal fluctuation.

Average annual runoff in the North Fork American River from 1942 through 1992 was 594,000 AF. North Fork American River flows have been estimated based upon upstream gage measurements. The dry season flow at just below the confluence with the Middle Fork averages about 1,100 cfs. However, flows during the summer periodically fluctuate to as low as 100 to 200 cfs because of upstream power production. The estimated peak flow of the 1.5-

year flood event is 12,400 cfs. The peak flow of the 100-year flood event is estimated to be 220,000 cfs (Reclamation 1996).

Available average daily flow records for the Middle Fork American River recorded at the Middle Fork American River near Oxbow Powerhouse gaging station) were obtained from the DWR's California Data Exchange Center (CDEC) website (http://cdec.water.ca.gov/). Mean monthly flows on the Middle Fork American River below Oxbow Powerhouse (Ralston Afterbay) for the March through December period (1997 through 2008[1)] ranged from a low of approximately 259 cfs in October to a high of approximately 1,526 cfs in March (**Table 3-1**). The lowest minimum monthly flow of 147 cfs occurred in November and the highest maximum monthly flow of 3,523 cfs occurred in February. These flows satisfy the minimum instream flow requirements of 75 cfs year-round at this location. The 75 cfs minimum fish flow release specified in Article 37 of the FERC license, was agreed to by California Department of Fish and Game (CDFG) and is, indirectly, a part of the SWRCB permit. As shown by these flow estimates, hydropower generation and subsequent Ralston Afterbay releases can vary greatly over a year.

Table 3-1. Minimum, Maximum, and Mean Monthly Flow (cfs) for the Middle Fork American River below Oxbow Powerhouse (Ralston Afterbay) during the January through December Period (1997-2008)

Monthly Flows	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	334	437	613	491	467	377	512	451	283	94	147	174
Maximum	1,972	3,523	2,582	4,027	3,117	2,267	1,326	1,094	820	517	765	1,735
Mean	1,051	1,525	1,526	1,520	1,472	1,052	762	719	564	259	515	783
Source: CDEC 2003												

French Meadows and Hell Hole Reservoirs

Construction of French Meadows and Hell Hole reservoirs was completed in 1966 and 1965, respectively. Maximum storage capacity is 136,000 AF in French Meadows Reservoir and 208,000 AF in Hell Hole Reservoir. French Meadows Reservoir is located in the upper Middle Fork American River watershed, about 16 miles west of Lake Tahoe. Hell Hole Reservoir is located about three miles southeast of French Meadows Reservoir on the Rubicon River. Water is released from these storage reservoirs downstream to Ralston Afterbay on the Middle Fork American River.

Lower American River

The lower American River consists of the 23-mile stretch of river from Nimbus Dam to the confluence of the American and Sacramento rivers in the City of Sacramento. Average lower American River annual flows downstream of Folsom Dam at Fair Oaks are approximately 2,650,000 AF (Reclamation 2004).

Folsom Reservoir and Dam

Folsom Reservoir is the principal reservoir on the American River, with a maximum storage capacity of 977,000 AF. Reclamation operates Folsom Dam and Reservoir for the purposes of flood control, meeting water contract water right obligations, providing downstream releases for the lower American River and helping to meet Delta water quality standards.

[1] Data are not available prior to 1997.

Flood-producing runoff occurs primarily during October through April and is usually most extreme during November through March. Snowmelt runoff usually does not result in flood-producing flows. The region's agricultural and M&I demands are met by water purveyors in areas upstream of, around, and downstream of Folsom Reservoir. The El Dorado Irrigation District, City of Roseville, San Juan Water District, California State Prison, and the City of Folsom are the main entities that divert water from Folsom Reservoir.

Lake Natoma and Nimbus Dam Lake Natoma serves as the Folsom Dam afterbay and was formed as a result of Nimbus Dam. Lake Natoma has a maximum storage capacity of 9,000 AF, and inundates approximately 500 acres. Lake Natoma is operated as a re-regulating reservoir that accommodates the diurnal flow fluctuations caused by the power peaking operations at Folsom Power Plant. Nimbus Dam, along with Folsom Dam, regulates water releases to the lower American River.

The minimum allowable flows in the lower American River are defined by SWRCB Decision 893 (D-893), which states that, in the interest of fish conservation, releases should not ordinarily fall below 250 cfs between January 2 and September 15 or below 500 cfs at other times. D-893 minimum flows are rarely the controlling objective of CVP operations at Nimbus Dam. Nimbus Dam releases are nearly always controlled during significant portions of a water year by either flood control requirements, fishery requirements under Central Valley Project Improvement Act (CVPIA) 3406(b)(2), or through coordination with other CVP and SWP releases to meet downstream SWRCB Decision 1641 requirements in the Delta and CVP water supply objectives (Reclamation 2004).

Rapid flow fluctuations in the lower American River are primarily in response to either flood control operations at Folsom Dam or operational changes in releases to meet SWRCB water quality standards in the Delta. The close proximity of Folsom Dam and Reservoir to the Delta, and the relatively short period of time for the releases to reach the Delta, result in Folsom Reservoir commonly being relied upon as the first response to meet Delta standards while releases from more distant CVP reservoirs take time to travel downstream. In the past, rapid flow fluctuations were common; however, Reclamation, after considering recommendations from the Lower American River Operations Group, presently attempts to minimize these fluctuations in both magnitude and frequency.

Sacramento River

The Sacramento River originates near the slopes of Mount Shasta and flows southward to Suisun Bay. The river drains 26,000 square miles with an average annual natural runoff of about 18,000,000 AF. Sacramento River flows are controlled primarily by Reclamation's Shasta Dam. Flows in the Sacramento River normally peak during December through February. The drainage area upstream of Sacramento is 23,502 square miles. The historical average annual flow for the Sacramento River at Freeport is 16,677,000 AF. The Feather and American rivers are the two largest contributors to the Sacramento River. The lower Sacramento River is defined as that section of the river downstream of its confluence with the lower American River.

Sacramento River flows are largely determined by the operation of upstream reservoirs (e.g., Shasta, Trinity, and Keswick) as well as the timing and rates of diversions from the Sacramento River and tributary streams. Diversions from the Sacramento River and tributary streams also influence seasonal flow levels by reducing overall flow volumes in the river. Shasta Reservoir is the largest CVP reservoir, storing up to 4,500,000 AF of water.

The natural flow pattern of the Sacramento River has been substantially altered due to a variety of river flow control facilities. Flows have been reduced during the wetter months due to upstream storage and diversions, but are typically higher during the drier months due to the requirements to set flows at levels capable of meeting water quality objectives and water delivery obligations. The flow of the Sacramento River can significantly vary from year-to-year and within a year. Flow in the Sacramento River is generally controlled by CVP and SWP operations, although periods of significant uncontrolled runoff continue to occur.

Shasta Reservoir and Dam Shasta Dam is located on the Sacramento River just below the confluence of the Sacramento, McCloud, and Pit rivers. The dam regulates the flow from a drainage area of approximately 6,649 square miles. Shasta Dam was completed in 1945, forming Shasta Reservoir, which has a maximum storage capacity of 4,552,000 AF. Water in Shasta Reservoir is released through or around the Shasta Power Plant to the Sacramento River where it is re-regulated downstream by Keswick Dam. A small amount of water is diverted directly from Shasta Reservoir for M&I uses by local communities.

Flood control objectives for Shasta Reservoir require that releases be restricted to quantities that will not cause downstream flows or stages to exceed specified levels. These include a flow limit of 79,000 cfs at the tailwater of Keswick Dam, and a stage of 39.2 feet in the Sacramento River at Bend Bridge gaging station, which corresponds to a flow of approximately 100,000 cfs. Flood control operations are based on regulating criteria developed by the Corps pursuant to the provisions of the Flood Control Act of 1944. Maximum flood space reservation is 1,300,000 AF, with variable storage space requirements based on an inflow parameter.

Keswick Reservoir and Dam Keswick Reservoir was formed by the completion of Keswick Dam in 1950. It has a capacity of approximately 23,800 AF and serves as an afterbay for releases from Shasta Dam and for discharges from the Spring Creek Power Plant. All releases from Keswick Reservoir are made to the Sacramento River at Keswick Dam. The dam has a fish trapping facility that operates in conjunction with the Coleman National Fish Hatchery on Battle Creek.

Wilkins Slough Historical commerce on the Sacramento River resulted in the requirement to maintain minimum flows of 5,000 cfs at Chico Landing to support navigation. There is currently no commercial traffic between Sacramento and Chico Landing, and the Corps has not dredged this reach to preserve channel depths since 1972. However, senior water rights holders diverting from the river have set their pump intakes just below this level. Therefore, the CVP is generally operated to meet the navigation flow requirement of 5,000 cfs to Wilkins Slough (gaging station on the Sacramento River) under all but the most critical water supply conditions to facilitate pumping.

At flows below 5,000 cfs at Wilkins Slough, diverters have reported increased pump cavitation as well as greater pumping head requirements. Diverters operate for extended periods at flows as low as 4,000 cfs at Wilkins slough, but pumping operations become severely affected and some pumps become inoperable at flows lower than this. Flows may drop as low as 3,500 cfs for short periods while changes are made in Keswick Reservoir releases to reach target levels at Wilkins Slough, but using the 3,500-cfs rate as a target level for an extended period would have major impacts on diverters.

No criteria have been established that specify when the navigation minimum flow should be relaxed. However, the basis for Reclamation's decision to operate at less than 5,000 cfs is the increased importance of conserving water in storage when water supplies are not sufficient to meet full contractual deliveries and other operational requirements.

Sacramento-San Joaquin Delta

The Delta lies at the confluence of the Sacramento and San Joaquin rivers. The Delta boundary extends north along the Sacramento River to just south of the American River, south along the San Joaquin River to just north of the Stanislaus River, east to the City of Stockton, and west to Suisun Bay. Runoff from a variety of Central Valley streams accounts for approximately 95 percent of the inflows into the Delta. The Delta receives flows directly from the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers. Inflows to the Delta averaged 27,800,000 AF annually from 1980 through 1991 and outflows to Suisun Bay averaged 21,020,000 AF (DWR 1993 as cited *in*: Reclamation 2001a). Delta inflows rely heavily on runoff from Central Valley streams, and thus, they also depend on the operations of water facilities on these streams. Releases from Shasta, Folsom, New Melones, and Millerton reservoirs of the CVP and Lake Oroville of the SWP, and several locally operated reservoirs in the San Joaquin River Basin control, to a large extent, how much and when freshwater enters the Delta.

Hydraulic conditions in the Delta are influenced by factors such as inflows from streams, tidal influences from the Pacific Ocean, operation of Delta export facilities, and water diversions within the Delta itself. Because the Delta is at or below sea level, tides significantly influence both the level and direction of flows through its channels. Tidal water level variations vary from one foot on the San Joaquin River near Interstate 5 to more than five feet at the outlet of the Delta, near the City of Pittsburg. The tidal currents carry with them large volumes of saltwater back and forth through the San Francisco-Bay Delta Estuary with each tide cycle. The mixing zone of saltwater and freshwater can shift two to six miles depending on the tides, and may reach far into the Delta during periods of low inflow. Thus, the inflow of the tributaries into the Delta is essential in maintaining the water quality in the Delta.

The Delta serves as a major operational focus for SWP and CVP project facilities (Figure 1-3). The CVP operates the Jones Pumping Plant to lift water from the southern Delta into the Delta-Mendota Canal to service CVP contractors in the San Joaquin Valley and the Tulare Basin. Current CVP and SWP operations in the Delta are governed by a series of regulations and agreements with the SWRCB, USFWS, National Marine Fisheries Service (NMFS), and CDFG. These regulations and agreements limit the volume of water that can be exported from the Delta based on Delta hydrodynamics, water quality, and potential impacts to fisheries as determined in part by: (1) fish population monitoring at the pumps; (2) a real time monitoring program implemented by the Interagency Ecological Program throughout the Bay-Delta; and (3) fish monitoring conducted on tributaries upstream of the Delta.

CVP Facilities and Operations

The CVP service area extends approximately 430 miles through much of California's Central Valley from Trinity and Shasta reservoirs in the north to Bakersfield in the south). The CVP is composed of some 18 reservoirs with a combined storage capacity of more than 11 million AF, 11 power plants, and more than 500 miles of major canals and aqueducts (Reclamation 2004). In most years, the combination of carryover storage and runoff in the Central Valley and runoff into CVP reservoirs is sufficient to provide the water to meet CVP contractors' demands. Since 1992, increasing constraints placed on operations by legislative and Endangered Species Act (ESA) requirements have removed some of the capability and operational flexibility required to deliver water to CVP contractors.

The CVP Delta Division facilities include the Delta Cross Channel, the Contra Costa Canal, the Jones Pumping Plant and associated fish collection facility, and the Delta-Mendota Canal.

The Delta Cross Channel is a gated diversion channel off the Sacramento River near Walnut Grove. When the gates are open, water flows from the Sacramento River through the Delta Cross Channel to the lower Mokelumne and San Joaquin rivers. The Delta Cross Channel is operated to improve water quality in the interior and southern Delta and to improve the transfer of water from the Sacramento River to the CVP and SWP export facilities in the south Delta.

The Jones Pumping Plant, located in the south Delta about five miles from the City of Tracy, is used to lift water from the Delta into the Delta-Mendota Canal. The pumping plant is located at the end of a 2.5-mile intake channel. At the head of the intake channel, louver screens intercept fish, which are collected and transported by tanker to release sites away from the pumps. Jones Pumping Plant consists of six pumps with a collective maximum rated capacity of about 5,100 cfs, although the permitted capacity is 4,600 cfs. When irrigation demands in the upper reaches of the Delta-Mendota Canal are low, pumping can be constrained by the capacity of the lower reaches of the Delta-Mendota Canal (Reaches 11 to 13) to 4,200 cfs.

Water exported at the pumps of the Jones Pumping Plant is conveyed via the Delta-Mendota Canal and via the joint reach of the California Aqueduct (San Luis Canal) to M&I and agricultural contractors in the San Joaquin Valley. Water from the Delta-Mendota Canal also may be pumped into San Luis Reservoir, where the water commingles with SWP water exported at Banks Pumping Plant. CVP water in San Luis Reservoir is subsequently either diverted to M&I and agricultural water users in Santa Clara and San Benito counties or released back into the Delta-Mendota Canal or the San Luis Canal via O'Neill Forebay.

CVP demands typically exceed pumping limitations at Jones Pumping Plant capacity in the spring and summer months. During this period, the CVP depends on releases from San Luis Reservoir to augment pumping at Jones Pumping Plant. In all but the driest years, there is limited or no unused pumping capacity at Jones Pumping Plant. When the water supply is available and exports are not limited by standards, the Jones Pumping Plant is operated continuously near the Delta-Mendota Canal capacity limits. However, Jones Pumping Plant exports are typically reduced during the spring to protect endangered fish and to meet water rights requirements and D-1641 criteria. In years that the capacity of Jones Pumping Plant is fully utilized, the CVP may wheel water through the SWP system using excess capacity at Banks Pumping Plant and the California Aqueduct.

Cross-Delta Water Transfers California's water market developed as a result of the last major drought in California (1987 to 1992) and has been facilitated by changes in Federal and State legislation pertaining to water rights and entitlements. The California legislature passed several laws in the 1980s and 1990s making it easier to transfer water beyond the boundaries of historical water service areas. These laws developed an expedited process for the SWRCB to temporarily change the water rights (i.e., point of diversion and place of use) of those conducting short-term (i.e., one-year) water transfers. Passage of the CVPIA in 1992 changed various policies of the CVP to allow water transfers among CVP contractors in prescribed situations.

Transfers requiring exports from the Delta are done at times when conveyance and pumping capacity at the CVP or SWP export facilities is available to move water. Parties to the transfer are responsible for providing the incremental change in flows required to protect Delta water quality standards and/or fish species.

Reclamation and DWR have operated water acquisition programs to provide water for environmental programs, and additional supplies to CVP contractors, SWP contractors, and other parties. DWR programs include the 1991, 1992, and 1994 Drought Water Banks, as well as the 2001, 2002, 2003, and 2004 Dry Year Programs. Almost 800,000 AF were purchased in 1991 as part of DWR's Drought Water Bank, and 1991 remains the largest water transfer year of record. Reclamation operated a forbearance program in 2001 by purchasing CVP contractors' water in the Sacramento Valley for CVPIA instream flows, and to augment water supplies for CVP contractors south of the Delta. Reclamation administers the CVPIA Water Acquisition Program for Refuge Level 4 supplies and fishery instream flows.

The surplus pumping capacity in the Delta available for water transfers varies with hydrologic conditions and with CVP and SWP allocations. In general, under wetter hydrologic conditions, surplus capacity is lower because the CVP more fully utilizes capacity for their own supplies. The CVP has little surplus capacity except in the driest hydrologic conditions.

Under low outflow conditions, increases in Delta exports can cause additional saltwater intrusion if the Delta outflow is not increased. Under these conditions additional releases are typically made from upstream reservoirs to match the increase in export pumping plus additional flows to maintain water quality. The additional increment of inflow (and corresponding increase in Delta outflow) that is needed to offset the additional effect of exports on saltwater intrusion, and prevent degradation of water quality at Delta drinking water intakes, is referred to as "carriage water."

SWP Facilities and Operation

SWP facilities in the Delta include the North Bay Aqueduct, Clifton Court Forebay, John E. Skinner Delta Fish Protection Facility, Harvey O. Banks Delta Pumping Plant, and the intake channel to the pumping plant. The North Bay Aqueduct would not be affected by the action alternatives, and therefore, is not discussed further. Banks Pumping Plant lifts water 244 feet to the beginning of the California Aqueduct. An open intake channel conveys water to Banks Pumping Plant from Clifton Court Forebay. The forebay provides storage for off-peak pumping and permits regulation of flows into the pumping plant. All water arriving at Banks Pumping Plant flows first through the primary intake channel of the John E. Skinner Delta Fish Protective Facility. Fish screens (louvers) across the intake channel direct fish into bypass openings leading into the salvage facilities. The main purpose of the fish facility is to reduce the number of fish adversely impacted by entrainment at the export facility and to reduce the amount of floating debris conveyed to the pumps.

Banks Pumping Plant facilities has a total of elevens pumps with a total capacity of 10,668 cfs; two pumps are rated at 375 cfs, five at 1,130 cfs, and four at 1,067 cfs. Water is pumped into the California Aqueduct, which extends 444 miles into southern California.

Operation of the SWP, in combination with CVP export operations, influences the hydrologic conditions within south-Delta channels. For example, export operations have an effect on water surface elevations within the south-Delta and subsequently operations of a number of siphons and irrigation pump diversions, which is being addressed, in part, through seasonal construction and operations of temporary barriers within the south-Delta channels. Export operations also influence water currents (both the direction and velocity) within various south-Delta channels, with the primary hydrologic effects occurring within Old and Middle rivers. Export operation effects on hydrologic conditions, and associated effects on habitat quality and availability for various fish and macroinvertebrates and the risk of entrainment and salvage at the CVP and SWP export facilities have been the subject of a number of programs. As a result, a number of management actions, including seasonal reductions in CVP and SWP export rates relative to Delta inflow (export/inflow [E/I] ratio) and other actions such as short-term reductions in export operations based on actual observed salvage of sensitive fish species as part of CALFED Environmental Water Account actions or in response BOs, have been implemented to reduce or avoid adverse effects of changes in hydrologic conditions and the vulnerability of species to salvage operations.

Currently, average daily diversions are limited during most of the year to 6,680 cfs, as set forth by Corps' criteria dated October 13, 1981. Diversions may be increased by one-third of San Joaquin River flow at Vernalis during mid-December to mid-March if that flow exceeds 1,000 cfs. The maximum diversion rate during this period would be 10,300 cfs, the nominal capacity of the California Aqueduct. In 2000 through 2002, the Corps has authorized use of an additional 500 cfs of Banks Pumping Plant capacity in July through September, which has been used to make up export supply lost during pumping curtailments undertaken during other months for fish protection.

Delta-Mendota Canal

The Delta-Mendota Canal, completed in 1951, carries water southeasterly from the Jones Pumping Plant along the west side of the San Joaquin Valley for irrigation supply, for use in the San Luis Unit, and to replace San Joaquin River water stored at Friant Dam and used in the Friant-Kern and Madera systems. The canal is about 117 miles long and terminates at the Mendota Pool, about 30 miles west of Fresno. The initial diversion capacity is 4,600 cfs, which is gradually decreased to 3,211 cfs at the terminus.

San Luis Reservoir

San Luis Reservoir is a storage facility south of the Delta, operated jointly by the CVP and SWP. Water is stored during the fall and winter months when Delta pumps can export more water than is needed for scheduled water demands. Similarly, water is released from San Luis Reservoir during spring and summer months when water demands are greater than the project's Delta export capacity. The total storage of San Luis Reservoir is 2,041,000 AF, of which 972,000 AF is dedicated to the CVP and 1,069,000 AF is dedicated to the SWP. San Luis Reservoir receives water from and releases water to O'Neill Forebay through the Gianelli Pumping-Generating Plant. The O'Neill Forebay also receives CVP supplies from the Delta-Mendota Canal via the Federal O'Neill Pump-Generating Plant, and SWP supplies from the California Aqueduct.

San Luis Reservoir is used to meet demand when water demands and schedules for CVP contractors served from the Delta-Mendota Canal exceed the combined capacity of the Jones Pumping Plant and the capacity of the State facilities (i.e., Banks Pumping Plant) to wheel water for the CVP. Typically, the fill cycle for the CVP's share of San Luis Reservoir begins in August or September, and the drawdown cycle begins in March or April. As irrigation demands decrease, the Jones Pumping Plant is used to convey water to refill the CVP portion of San Luis Reservoir. The Jones Pumping Plant generally continues to operate near the maximum diversion rate until early spring, unless San Luis Reservoir is filled or the Delta water supply is not available.

San Luis Canal

This joint CVP/SWP facility is a concrete-lined canal with a capacity ranging from 8,350 to 13,100 cfs. The San Luis Canal is operated by DWR and extends 102.5 miles from the O'Neill Forebay, near Los Banos, in a southeasterly direction to a point west of Kettleman City. The 138-foot-wide channel is 36 feet deep, 40 feet wide at the bottom, and lined with concrete.

Coalinga Canal

This Federal facility, formerly called Pleasant Valley Canal, carries water from the turnout structure on the San Luis Canal to the Coalinga area in Fresno County. The 12-mile concrete-lined system includes a 1.6-mile intake channel to the Pleasant Valley Pumping Plant and 11.6 miles of canal. The initial capacity of the canal is 1,100 cfs, decreasing to 425 cfs at the terminus. Reaches 1 and 2 of the canal are operated by WWD (Reclamation 2008b).

3.2.2 Regulatory Setting

Central Valley Project Improvement Act

The Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law (PL) 102-575), includes Title 34, the CVPIA. Among the changes mandated by the CVPIA was dedication of 800,000 AF annually to fish, wildlife, and habitat restoration. The Department of Interior's May 9, 2003 decision on Implementation of Section 3406 (b)(2) of the CVPIA provides the basis for implementing upstream and Delta actions for fish management purposes. Implementation of Section 3406 (b)(2) includes Jones Pumping Plant export curtailment for fishery management protection and augmenting instream flows, based on USFWS recommendations.

Long-Term Central Valley Project and State Water Project Operations Criteria and Plan

The Long-Term CVP and SWP Operations and Criteria Plan (OCAP) serves as the operational standard by which Reclamation operates the integrated CVP/SWP system. The OCAP describes how Reclamation and DWR operate the CVP and the SWP to divert, store, and convey water consistent with applicable law (Reclamation 2004). Reclamation and DWR completed an update to the OCAP in 2004 to reflect operational and environmental changes occurring throughout the CVP/SWP system. Additionally, Reclamation received BOs from both the USFWS and NMFS in 2004. The terms and conditions identified in the USFWS and NMFS BOs establish the instream habitat conditions and operational requirements that Reclamation and DWR must maintain as part of integrated CVP/SWP operations. Both the USFWS and NMFS BOs were declared to be incomplete and unlawful by the Federal court. USFWS and NMFS are in the process of completing new BOs and in the interim the CVP is operating under the 2004 BOs with additional court ordered operational constraints to protect the endangered and threatened fish species. The new BOs are expected to be completed this winter.

Coordinated Operations Agreement

The Coordinated Operations Agreement (COA) defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and the water demands of senior water right holders, and how the two agencies share surplus flows (Reclamation and DWR 1986). The COA defines the Delta as being in either “balanced water conditions” or “excess water conditions.” Balanced water conditions are periods when Delta inflows are just sufficient to meet water user demands within the Delta, outflow requirements for water quality and flow standards, and export demands. Under excess water conditions, Delta outflow exceeds the flow required to meet the water quality and flow standards. Typically, the Delta is in balanced water conditions from June to November, and in excess water conditions from December through May. However, depending on the volume and timing of winter runoff, excess or balanced water conditions may extend throughout the year.

Water Right Decision 1641 and Water Quality Control Plan for San Francisco Bay/Sacramento-San Joaquin Delta Estuary

SWRCB Water Right Decision 1641 (D-1641) contains the current water right requirements to implement the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP). D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. The SWRCB imposed terms and conditions on the water rights held by Reclamation and DWR that require them, in some circumstances, to meet many of the water quality objectives established in the 1995 WQCP. D-1641 also authorizes the CVP and SWP to use joint points of diversion (JPOD) in the south Delta, and recognizes the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards.

The 1995 Water Quality Control Plan (WQCP) established water quality control objectives for the protection of beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives. The SWRCB adopted a new Bay/Delta WQCP on December 13, 2006. However, the 2006 WQCP made only minor changes to the 1995 WQCP.

Joint Point of Diversion

The JPOD refers to the CVP and SWP use of each other's pumping facilities in the south Delta to export water from the Delta. In 1978, by agreement with DWR and with authorization from SWRCB, the CVP began using the SWP Banks Pumping Plant for replacement pumping (195,000 AF per year) for pumping capacity lost at Jones Pumping Plant because of striped bass pumping restrictions in Decision 1485. In 1986, Reclamation and DWR formally agreed that "either party may make use of its facilities available to the other party for pumping and conveyance of water by written agreement" and that the SWP would pump CVP water to make up for striped bass protection measures (Reclamation and DWR 1986).

3.3 Surface Water Quality

This section describes aspects of the affected environment relating to the surface water quality in the rivers and reservoirs of the Action Area that may be affected if the action alternatives are implemented.

3.3.1 Environmental Setting

Middle Fork and North Fork American River

Water quality in the American River is considered to be good, although historical water quality data for the North and Middle Forks American rivers are sparse (Corps 1991). Information on sediment in the river is not readily available; however, turbidity results indicate that the river carries relatively little sediment during low flows. Several wastewater sources discharge into the North and Middle Fork American rivers or to their tributaries. Sources of wastewater discharge include two sawmills located at Foresthill; one is on a tributary to Devil's Canyon and the North Fork American River, and the other discharges directly into the Middle Fork American River. Levels of pH have exceeded objectives in the Middle Fork American River. This exceedance is attributable to photosynthetic activity (Placer County 1994a).

French Meadows Reservoir Due to its position high in the watershed its inflow mainly comes from snowmelt and as a result the reservoir does not receive a high level of contaminants. Water quality in French Meadows Reservoir is generally considered to be of good quality.

Hell Hole Reservoir Hell Hole Reservoir, located within the El Dorado National Forest, receives flows from the Rubicon River, a tributary of the Middle Fork American River. Because it is high in the watershed, its inflow mainly comes from snowmelt and as a result does not receive a high concentration of contaminants. Water quality in Hell Hole Reservoir is generally considered to be of good quality.

Folsom and Natoma Reservoirs

Water quality in Folsom Reservoir and Lake Natoma is generally acceptable for the beneficial uses currently defined for these waterbodies. Temperature, dissolved oxygen, conductivity, and toxic metals concentrations generally do not exceed recommended limits.

However, comments about taste and odor have occurred in municipal water supplies diverted from Folsom Reservoir, which were attributed to blue-green algae blooms that occasionally occur in the reservoir as a result of elevated water temperatures during late summer.

The Office of Environmental Health Hazard Assessment (OEHHA) is responsible for providing fish consumption guidelines for sport fish in California. On October 9, 2008, OEHHA issued a health advisory and "safe eating guidelines" based on studies of mercury levels in fish from Folsom Reservoir and Lake Natoma, which have shown that many fish from this area contain mercury at levels that call for recommendations to protect health. For example, in Folsom Reservoir and Lake Natoma, black bass (including largemouth, smallmouth, and spotted bass) and catfish were found to have higher levels of mercury than other fish species. Ocean and river-run salmon, which usually do not eat once they enter the river, typically contain low levels of mercury. Water released from Folsom Reservoir through Lake Natoma and into the lower American River affects numerous water quality parameters in the river. In addition, operation of Folsom Dam and Reservoir directly affects the lower American River water temperatures throughout much of the year.

Lower American River Water quality parameters for the lower American River have typically been well within acceptable limits to achieve water quality objectives and beneficial uses identified for this waterbody (SWRCB 1998). Principal water quality parameters of concern for the river (i.e., pathogens, nutrients, total dissolved solids (TDS), total organic carbon (TOC), priority pollutants, and turbidity) are primarily affected by urban land use practices and associated runoff and stormwater discharges. TOC and TDS levels in the lower American River are relatively low compared to Sacramento River and Delta and thus are generally not of substantial concern. Heavy metal concentrations in the river are typically within the range of drinking water standards (City of Sacramento 1993). Comments on taste and odor can occur in water taken from the lower American River, primarily during late summer. The problems are attributable to increased concentrations of an actinomyces microorganism, which is associated with elevated summer temperatures.

Over the years, Aerojet and Cordova Chemical disposed of hazardous waste by burial, open burning, discharge into unlined ponds, and injection into deep underground wells. Some of these discharges contaminated the groundwater beneath the site with several chemicals of health concern, including volatile organic compounds, perchlorate, and n-nitrosodimethylamine. Over time, the contaminated water reached the location of drinking water wells used by private residences as well as the cities of Rancho Cordova, Carmichael, Fair Oaks, and Folsom, and some unincorporated areas of Sacramento County. Aerojet treated ground water currently discharges into the lower American River at Buffalo Creek (30,000 AF/year). The treated water is not acceptable for use until diluted by a natural water body.

Sacramento River

Water originating from the Sacramento River drainages represents a significant component of the total CVP supply, which provides high quality water to meet downstream urban and agricultural demands. The Sacramento River Watershed Program has identified mercury, organophosphate pesticides, toxicity, and drinking water parameters as chemicals of concern in the Sacramento River watershed, which includes the Sacramento and Feather rivers, and the Delta (Sacramento River Watershed Program 2001).

The upper Sacramento River sampling site is above Bend Bridge near Red Bluff and is located 52 miles downstream of Shasta Dam. Stream flow is greatly influenced by managed releases from Shasta Reservoir, and during the rainy season by storm water runoff. The stream channel is in a natural state with no artificial levees at this location. The drainage basin area at this site is 9,100 square miles and includes parts or all of the Great Basin, Middle Cascade Mountains, Klamath Mountains, Coast Ranges, and Sacramento Valley physiographic provinces.

The lower Sacramento River receives urban runoff, either directly or indirectly (through tributary inflow) from the cities of Sacramento, Roseville, Folsom, and their surrounding communities. The Natomas East Main Drainage Canal discharges to the American River immediately upstream of its confluence with the Sacramento River. This canal transfers both agricultural discharges and urban runoff into the Sacramento River.

Sacramento-San Joaquin Delta

The Delta is the source of drinking water for more than 23 million Californians in the San Francisco Bay area, Central Valley, and Southern California. Recognized water quality issues in the Delta include the following (Reclamation and DWR 2005).

High salinity from Suisun Bay intrudes into the Delta during periods of low Delta outflow. Salinity can adversely affect agricultural, M&I, and recreational uses. Delta exports contain elevated concentrations of disinfection by-product precursors (e.g., dissolved organic carbon [DOC]) and bromide that increases the potential for the formation of brominated compounds in treated drinking water).

Agricultural drainage in the Delta contains high levels of nutrients, suspended solids, DOC, minerals (salinity), and pesticides. Synthetic and natural contaminants have bioaccumulated in Delta fish and other aquatic organisms. Synthetic organic chemicals and heavy metals are found in Delta fish in quantities occasionally exceeding acceptable standards for food consumption.

The San Joaquin River flows are of relatively poorer quality than flows from the Sacramento River, with agricultural and refuge drainage to the river being a major source of salts and pollutants. Because the south Delta receives a substantial portion of water from the San Joaquin River, the influence of San Joaquin River water quality is greatest in the south Delta channels and in the CVP and SWP exports.

Prolonged reverse flow has the potential to adversely affect water quality in the Delta and at the export pumps by increasing salinity unless Delta outflow is increased by the CVP and SWP to offset that effect (DWR and Reclamation 1996; SWRCB 1997; CALFED 2000).

The existing water quality constituents of concern in the Delta can be categorized broadly as metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon. Water quality constituents that are of specific concern with respect to drinking water, including salinity, bromide, and organic carbon.

San Luis Reservoir

Because the reservoirs within the CVP/SWP system are operated in a coordinated manner to the various demands throughout California, changes in the timing and magnitude of exports from the Delta, if they were to occur, could indirectly result in changes to Delta flows and water surface elevations in San Luis Reservoir.

During the summer months when water levels are low, water quality in San Luis Reservoir may deteriorate due to a combination of higher water temperatures, wind-induced nutrient mixing, and algal blooms near the reservoir surface. The reservoir also has an unusual configuration with a very large surface area and a relatively shallow depth, which contributes to algal blooms.

3.3.2 Regulatory Setting

Water Right Decision 1641 and Water Quality Control Plan for San Francisco Bay/Sacramento-San Joaquin Delta Estuary

SWRCB Water Right Decision 1641 (D-1641) contains the current water right requirements to implement the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP). D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. The SWRCB imposed terms and conditions on the water rights held by Reclamation and DWR that require them, in some circumstances, to meet many of the water quality objectives established in the 1995

The 1995 WQCP established water quality control objectives for the protection of beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives. Key features of the 1995 WQCP include estuarine habitat objectives for Suisun Bay and the western Delta (consisting of a salinity measurement (i.e., X2) at several locations), E/I ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, and San Joaquin River electrical conductivity (EC) and flow standards. The SWRCB adopted a new WQCP on December 13, 2006, which made only minor changes to the 1995 WQCP.

3.4 Hydropower

Hydroelectric facilities generate a significant portion of California’s energy requirements. Water agencies and private electric utilities own and operate in-stream reservoirs that store and release water to generate hydroelectric power. Electric utilities produce power for their customers, while water agencies produce power for their own use and market the excess to electric utilities, government and public installations, and commercial customers. Hydropower facilities that rely on water from the Middle Fork American River watershed include the PCWA MFP and CVP facilities downstream of the Middle Fork American River.

The hydroelectric facilities included in the project study area are listed below by region and river in **Table 3-2**.

Table 3-2. Hydroelectric and Pumping Plant Facilities Located in the Action Area

Location	Reservoir/Dam	Pumping/Generating Plant	Owner/Operator
American River			
Middle Fork American River	French Meadows Reservoir and Dam	French Meadows Power Plant	PCWA
Middle Fork American River	Hell Hole Reservoir and Dam	Hell Hole Power Plant	PCWA
Middle Fork American River	Middle Fork – Ralston Afterbay	Lowell J. Stephenson Power Plant	PCWA
Middle Fork American River	Ralston Afterbay	Ralston Power Plant	PCWA
Middle Fork American River	Oxbow Reservoir	Oxbow Power Plant	PCWA
Lower American River	Folsom Reservoir and Dam	Folsom Power Plant	Reclamation (CVP)
Lower American River	Nimbus Lake and Dam	Nimbus Power Plant	Reclamation (CVP)
CVP Upstream of the Delta			
Sacramento River	Shasta Dam	Shasta Power Plant	Reclamation (CVP)
Sacramento River	Keswick Dam	Keswick Power Plant	Reclamation (CVP)
CVP and SWP in the Delta			
South Delta		Harvey O' Banks Pumping Plant	Reclamation (CVP)
South Delta		Jones Pumping Plant	DWR (SWP)
South of Delta			
South of Delta	O'Neill Forebay	O'Neill Pumping-Generating Plant	Reclamation (CVP)
South of Delta	San Luis Reservoir	William R. Gianelli Pumping-Generating Plant	Reclamation (CVP)

3.4.1 Regulatory Setting

Federal

The Action Area comprises CVP facilities located upstream of the Delta, in the Delta, and in the CVP Export Service Area. CVP hydroelectric generation facilities are operated by Reclamation. Hydropower operations at these facilities must comply with regulations governing flows in the downstream river reaches and flow requirements in the Delta.

Local

PCWA's activities on the North Fork and Middle Fork American rivers are regulated through a series of licenses, permits, contracts, and laws. The primary focus of these regulations is the flow in the Middle Fork American River; however; powerhouse operations are also subject to control by some of these regulations. Operation of the MFP by PCWA is governed by FERC license (Project No. 2079) and a contract with PG&E.

3.4.2 CVP Hydropower System

The Action Area, used to evaluate the potential effects of the action alternatives on hydropower generation and electrical energy consumption, includes CVP hydroelectric facilities located in the following regions: (1) CVP upstream of the Delta (e.g., the Sacramento River); (2) the Delta; and (3) the San Joaquin Valley along the San Luis Canal.

CVP power is a source of electricity for CVP pumping facilities throughout the Central Valley and the Delta, and for many of California's communities. The Western Area Power Administration (Western) sells excess CVP capacity and energy to municipal utilities, irrigation districts, and institutions and facilities such as schools, prisons, and military bases. The CVP sells power at rates designed to recover costs. For the CVP, these rates historically have been slightly below market rates. Revenue from Western power sales is an important funding source for the CVP Restoration Fund and for repaying project debt incurred during construction of the CVP.

The hydroelectric generation facilities of the CVP are operated by Reclamation. Reclamation manages and releases water in accordance with the various acts authorizing specific projects and in accordance with other laws and enabling legislation. Hydropower operations at each facility must comply with minimum and maximum flows and other constraints set by Reclamation, USFWS, or other regulatory agencies, acting in accordance with law or policy.

CVP water demands are highest during the summer (June through August). Releases to meet these water demands produce energy at the upstream reservoirs and at San Luis Reservoir. Although generation at CVP power plants is high because of releases for CVP water demands, pumping loads combined with CVP power customer loads frequently require the import of additional energy from the Pacific Northwest.

During the fall (September through November) agricultural demands are low, and the CVP and SWP start to fill San Luis Reservoir. CVP generation is sufficient in the fall months to satisfy power pumping requirements and CVP power customer load requirements.

The principal purpose of the Folsom and Nimbus power plants is to generate power using the water releases mandated for downstream appropriators, flood control, fish, and other uses.

The Folsom Power Plant is at the foot of Folsom Dam on the north side of the American River. The Folsom Power Plant has three generating units, with a combined capacity of 215 megawatts (MW) (Reclamation 2001), and a total release capacity of approximately 8,600 cfs. By design, the facility is operated as a peaking facility. Peaking plants schedule the daily water release volume during the peak energy demand hours to maximize generation at the time of greatest need. During other hours of the day, the plant may release little or no water, generating little or no power. The Folsom Power Plant generates an average annual 620,000 megawatt hours (MWh). Both the power and power plant releases mentioned above are maximums that are based on a maximum reservoir elevation of 465 feet.

Pumping energy requirements are affected by total reservoir storage, because less storage means that water must be lifted a greater height from the reservoir surface. Reductions in Folsom Reservoir elevations caused by the action alternatives would increase energy requirements for pumping water at the Folsom Pumping Plant and the EID pumping plant at Folsom Reservoir. These impacts, like those for hydropower, would not be expected to cause direct environmental effects, but would have economic consequences and may cause indirect effects requiring additional energy generation. Folsom Dam is primarily a flood control facility and during a flood event it will be operated to minimize downstream flooding. Folsom Dam also has the ability to release (bypassing power generation) about 28,600 cfs through the River Outlet Works.

The Nimbus Power Plant is on the right abutment of Nimbus Dam (Lake Natoma) on the north side of the American River. To avoid fluctuations in flow in the lower American River, Nimbus Dam and Lake Natoma serve as a regulating facility. While the water surface elevation fluctuates, releases to the lower American River remain constant. The Nimbus Power Plant consists of two generating units with a release capacity of approximately 5,100 cfs (Reclamation 2001). Electric generation from this facility is continuous throughout the day.

The Shasta Power Plant, constructed in 1944, is a CVP facility at the foot of Shasta Dam on the Sacramento River. Water from the dam is released through the 15-foot diameter penstocks (power plant intake pipeline) leading to the five main generating units and two station service units. Shasta Power Plant is a peaking plant and produces power on a schedule corresponding to peak electrical system usage rather than at a constant rate of 24-hours per day. Its power is dedicated first to meeting the requirements of the project facilities. The plant's installed capacity is 629,000 kW and it has an annual average net generation of 2,466 gigawatt hours (GWh) (Reclamation and PWCA 2002). The energy remaining after meeting CVP project use needs is marketed to various preference customers throughout California.

The Keswick Power Plant, constructed in 1949, is a CVP facility just below Keswick Dam on the Sacramento River. Unlike Shasta, the Keswick Power Plant runs throughout the day at a constant rate, providing a uniform release to the Sacramento River. The Keswick Power Plant has three generating units with a combined capacity of 117,000 kW and has an average annual net generation of 399.3 GWh (Reclamation 2002).

3.4.3 Middle Fork Project

The MFP (Figure 1-1) is a multipurpose project that uses the waters of the Middle Fork of the American River, the Rubicon River, and certain tributaries for irrigation, domestic, and commercial purposes and for the generation of electric energy. Principal features of the Middle Fork Project are two storage and five diversion dams, five power plants, diversion and water transmission facilities, five tunnels, and related facilities. The power plants have a combined generating capacity of 223,753 kW and include Hell Hole, French Meadows, Lowell J. Stephenson, Ralston, and Oxbow. The power division of PCWA operates the MFP.

PCWA diverts water from French Meadows Reservoir through the French Meadows-Hell Hole Tunnel. The water passes through the Francis turbine at the power plant, which has a capacity of 15,300 kW (Jones, pers. comm. 2004). French Meadows Power Plant generates an average of 5,200 MWh monthly. The water is then held in Hell Hole Reservoir.

The Hell Hole Power Plant is on the Rubicon River at Hell Hole Reservoir. Water flows from the reservoir through the Hell Hole Dam to the Hell Hole Power Plant. The Hell Hole Power Plant has a capacity of 725 kW (Jones, pers. comm. 2004) and generates an average of 190 MWh monthly. From the plant, the water flows through a tunnel to the Ralston Afterbay.

The Lowell J. Stephenson Power Plant is on the Middle Fork American River at the Middle Fork Interbay. Water for the power plant comes from French Meadows Reservoir, through the French Meadows Tunnel, through Hell Hole Reservoir, and finally through the Middle Fork Tunnel. The water passes over the impulse turbine at the power plant, which has a capacity of 122,400 kW (Jones, pers. comm. 2004). The water flows from the power plant through the Ralston Tunnel. The Lowell J. Stephenson Power Plant generates an average of 43,100 MWh monthly.

The Ralston Power Plant is on the Rubicon River at the Ralston Afterbay. Water for the Ralston Power Plant follows the same path as the water for the Lowell J. Stephenson Power

Plant, through the Ralston Tunnel to the Ralston Power Plant. The Ralston Power Plant has an impulse turbine and a capacity of 79,200 kW (Jones, pers. comm. 2004). The Ralston Power Plant generates an average of 31,200 MWh monthly. From the plant, the water flows back into the Ralston Tunnel, which continues to the Oxbow Power Plant (below).

The Oxbow Power Plant is on the Middle Fork of the American River at the Oxbow Bar. Water for the Oxbow Power Plant flows from the Ralston Power Plant through the Ralston Tunnel. The plant has a Francis turbine and a capacity of 6,128 kW (Jones, pers. comm. 2004).

3.5 Fisheries and Aquatic Resources

This section describes the affected environment related to fisheries and aquatic resources in water bodies that may be influenced by implementation of the proposed temporary water transfer to WWD and WWDD1. The following sections describe the aquatic habitats and fish populations within the North Fork and Middle Fork American rivers, lower American River, Sacramento River, and the Delta.

Life histories and life stage-specific environmental considerations for several species may differ slightly among the water bodies. Any differences are noted in the discussions of the individual water bodies. If there are not any noted differences, the species life history and general environmental considerations are assumed to be identical to the general discussions in the following section.

3.5.1 Overview of Fish Species in the Lower American River, Sacramento River, and Delta

Species of primary management concern include those that are recreationally or commercially important (fall-run Chinook salmon [Oncorhynchus tshawytscha], steelhead [Oncorhynchus mykiss], American shad [Alosa sapidissima], and striped bass [Morone saxatilis]); Federal- and/or State-listed species within the Action Area (winter- and spring-run Chinook salmon, steelhead, delta smelt [Hypomesus transpacificus], and green sturgeon [Acipenser medirostris]); and State species of special concern (late fall-run Chinook salmon,[2] green sturgeon, hardhead [*Mylopharodon conocephalus*], longfin smelt [*Spirinchus thaleichthys*], river lamprey [*Lamptera ayresi*], Sacramento perch [*Archoplites interruptu*], Sacramento splittail [*Pogonichthys macrolepidotus*], and California roach [*Hesperoleucus symmetricus*]). **Table 3-3** presents the special-status fish species that could occur within the Action Area, their regulatory status, and the water body where each species is anticipated to occur.

[2] NMFS recognizes the late-fall-run Chinook salmon in the Central Valley fall-run ESU (Moyle 2002). On April 15, 2004, NMFS published a notice in the Federal Register acknowledging establishment of a species of concern list, addition of species to the species of concern list, description of factors for identifying species of concern, and revision of the candidate species list. In this notice, NMFS announced the Central Valley fall-run and late fall-run Chinook salmon ESU change in status from a candidate species to a species of concern. In 1999, the Central Valley ESU underwent a status review after NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under the ESA, but sufficient concerns remained to justify addition to the candidate species list. Therefore, according to NMFS' April 15, 2004 interpretation of the ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

Table 3-3. Special-Status Fish Species within the Action Area

Common Name	Scientific Name	Status (see below)	Location
Central Valley fall-/late fall-run Chinook salmon	Oncorhynchus tshawytscha	CSC	Lower American River, Sacramento River, and the Delta
Central Valley spring-run Chinook salmon	Oncorhynchus tshawytscha	T, ST	Lower American River, Sacramento River, and the Delta
Central Valley winter-run Chinook salmon	Oncorhynchus tshawytscha	E, SE	Sacramento River and the Delta
Central Valley steelhead	Oncorhynchus mykiss	T	Lower American River, Sacramento Rive, and the Delta
Delta smelt	Hypomesus transpacificus	T, ST	Delta
Southern Distinct Population Segment of North American green sturgeon	Acipenser medirostris	T, CSC	Sacramento River and the Delta
Hardhead	Mylopharodon conocephalus	CSC	Lower American River and Sacramento River
Longfin smelt	Spirinchus thaleichthys	CSC	Delta
River lamprey	Lampetra ayresi	CSC	Lower American River, Sacramento River,and the Delta
Sacramento perch	Archoplites interruptus	CSC	Sacramento River and the Delta
Sacramento splittail	Pogonichthys macrolepidotus	CSC	Lower American River, Sacramento River, and the Delta
California roach	Hesperoleucus symmetricus	CSC	Lower American River and Sacramento River

Status Key:

E = Endangered	Officially listed (in the Federal Register) as being endangered
T = Threatened	Federally listed as likely to become endangered within the foreseeable future
SE = State Endangered	State listed as endangered
ST = State Threatened	State listed as likely to become endangered
CSC = State Species of Special Concern	CDFG species of special concern

Special emphasis is placed on these species of primary management concern to facilitate compliance with applicable laws, particularly the State and Federal ESAs, and NMFS and USFWS BOs. This focus is consistent with: (1) CALFED’s 2000 Ecosystem Restoration Program Plan (ERPP) and Multi-Species Conservation Strategy (MSCS); (2) the programmatic determinations for the CALFED program, which include CDFG’s Natural Community Conservation Planning Act (NCCPA) approval and the programmatic BOs issued by NMFS and USFWS; (3) USFWS's 1997 Draft Anadromous Fish Restoration Program (AFRP), which identifies specific actions to protect anadromous salmonids; (4) CDFG’s 1996 Steelhead Restoration and Management Plan for California, which identifies specific actions to protect steelhead; and (5) CDFG’s Restoring Central Valley Streams, A Plan for Action (1993), which identifies specific actions to protect salmonids. Improvement of habitat conditions for these species of primary management concern could protect or enhance conditions for other fish resources, including native resident species.

Evaluating potential impacts on fishery resources within the Action Area requires an understanding of fish species' life histories and life stage-specific environmental requirements. General information is provided below regarding life histories of fish species of primary management concern occurring within the study area. Time periods associated with individual species life stages are derived from a combination of literature review and analyses of survey data. Appendix A contains detailed accounts for the special-status fish species in the Action Area.

3.5.2 Environmental Setting

Middle Fork and North Fork American Rivers

The Middle Fork American River supports coldwater fish species year-round. The primary sport species in the Middle Fork American River are resident rainbow and brown trout (*Oncorhynchus mykiss* and *Salmo trutta*) (PCWA 2001). In addition to rainbow and brown trout, fish sampling surveys of the Middle Fork American River conducted by the USFWS in 1989 from Ralston Afterbay downstream to the confluence with the North Fork American River, documented the presence of hitch (*Lavinia exilicauda*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), and riffle sculpin (*Cottus gulosus*) (Corps 1991). No special-status fish species are reported to occur in the Middle Fork American River.

Brown trout are resident stream fish, spending their entire life cycle in fresh water. Spawning generally occurs during November and December in California. Brown trout fry typically hatch in seven to eight weeks, depending on water temperature, with emergence of young three to six weeks later (Moyle 2002). Optimal riverine habitat for brown trout reportedly consists of cool to coldwater, silt-free rocky substrate, an approximate 1:1 pool-to-riffle ratio, and relatively stable water flow and temperature regimes (Raleigh et al. 1986). Moyle (2002) reported that while brown trout will survive for short periods at temperatures in excess of 82.4°F to 84.2°F (28C to 29°C), optimum temperatures for growth range from 62.6°F to 64.4°F (17°C to 18°C). Brown trout tend to utilize lower reaches of low to moderate gradient areas (less than one percent) in suitable, high gradient rivers (Raleigh et al. 1986).

Warmwater species generally have wider thermal tolerance ranges and generally broader habitat preferences than salmonids and other coldwater species. Specifically, warmwater species such as Sacramento pikeminnow and Sacramento sucker typically are found together in low- to mid-elevation streams and rivers with deep pools, long runs, undercut banks, and overhanging vegetation. They generally live in waters with summer water temperatures of approximately 59°F to 64.4°F (15°C to 18°C), to 82.4°F to 86°F (28°C to 30°C) (Moyle 2002). Many other warmwater species including a variety of minnow and bass species exhibit similarly wide ranges within their habitat and thermal requirements.

Little information is available on fish populations in the Middle Fork American River below Oxbow Reservoir. Trout production has been suggested to be relatively low because of large daily fluctuations in flow associated with hydroelectric peaking operations at Oxbow Powerhouse (PCWA 2001). The current FERC license for the MFP provides that the Oxbow Power Plant releases to the Middle Fork American River shall not cause vertical fluctuations in stream stages (measured in a representative section) greater than one foot per hour. However, such fluctuations have the potential to affect stream productivity, especially during periods when flows would otherwise be fairly stable (i.e., summer and early fall).

Hydropower peaking operations can adversely affect stream communities because of unstable habitat conditions in which benthic algae, invertebrates, and fish are frequently subjected to exposure, stranding, and/or displacement from preferred habitats. Stranding and isolation of aquatic organisms from the flowing portion of the stream can lead to increased mortality due to exposure to direct solar radiation, elevated water temperatures, low dissolved oxygen, and predation (PCWA 2001).

Downstream of its confluence with the Middle Fork American River, the North Fork American River supports warmwater fish species year-round. These species include smallmouth bass (*Micropterus dolomieu*), Sacramento pikeminnow, Sacramento sucker, riffle sculpin, brown bullhead (*Ictalurus nebulosus*), and green sunfish (*Lepomis cyanellus*). Although some rainbow and brown trout are present, summer and fall water temperatures are generally too warm for significant spawning and early-life stage rearing of trout. The majority of trout that do occur in the North Fork American River below the confluence with the Middle Fork American River are believed to be transitory downstream adult and/or sub-adult migrants that have dispersed into the area from upstream habitats (i.e., Middle Fork American River). No special-status fish species are reported to occur in the North Fork American River.

There is little available information on fish populations and benthic macroinvertebrate communities in this reach of the North Fork American River. However, aquatic habitat requirements for cold and warmwater fish species are similar to those previously described for the Middle Fork American River.

French Meadows Reservoir French Meadows Reservoir supports coldwater recreational fisheries for resident rainbow and brown trout, sustained largely by annual stocking of catchable trout. CDFG stocks French Meadows Reservoir with rainbow and brown trout during June and July. The reservoir also supports a self-sustaining population of brown trout that migrates from the reservoir to spawning areas in the Middle Fork American River above the reservoir during the fall. No physical barriers to brown trout migration are present in the Middle Fork American River within two miles above the reservoir during the fall. Fish production in the reservoir is believed to be limited by its high elevation, large seasonal fluctuations in water levels, and low productivity compared to natural lakes (Jones and Stokes 2001).

For general public information, CDFG lists on their website, Fisheries Program Branch California Fisheries Information (CDFG 2003), that the prevalent sport fish species are rainbow and brown trout. The website also suggests that warmwater species such as largemouth bass, sunfish and catfish also may be present in French Meadows Reservoir.

Hell Hole Reservoir Hell Hole Reservoir is a mid-elevation, oligotrophic Sierra Nevada reservoir (having elevations of approximately 5,000 feet above mean sea level [msl]) that supports coldwater recreational fisheries for resident rainbow and brown trout. CDFG stocks Hell Hole Reservoir with resident rainbow and brown trout once a year. Hell Hole Reservoir may also support lake trout and Kokanee salmon populations. Warmwater fisheries also exist, including smallmouth bass, catfish, and sunfish. Fish production in the reservoir is believed to be limited by large seasonal fluctuations in water levels and low productivity compared to natural lakes (Jones and Stokes 2001).

Middle Fork Interbay Reservoir The Middle Fork Interbay Reservoir is located between the Hell Hole-Middle Fork Tunnel and the Middle Fork-Ralston Tunnel. Fish assemblages found in the reservoir include some or all of the species known to occur in the Middle Fork American River and the Rubicon River (e.g., rainbow and brown trout). The reservoir also may provide habitat for native nongame species and possibly overwintering habitat for trout (Jones and Stokes 2001). Cold and warmwater fisheries habitat utilization is expected to be similar to that found in other previously discussed waterbodies.

As a regulating afterbay, its monthly storage and elevation fluctuate significantly on a daily and hourly basis. Therefore, changes in releases from Hell Hole and French Meadows reservoirs would not affect monthly mean storage or elevation. Therefore, no quantitative discussion of potential storage- or elevation-related impacts to fishery resources in this water body is warranted.

Oxbow Reservoir Fish assemblages found in Oxbow Reservoir include some or all of the species known to occur in the Middle Fork American River and the Rubicon River (e.g., rainbow and brown trout). The reservoir may provide habitat for native nongame species and possibly overwintering habitat for trout (Jones and Stokes 2001). Cold and warmwater fisheries habitat utilization is expected to be similar to that found in other previously discussed waterbodies.

Lower American River

At least 43 species of fish have been reported to occur in the lower American River system, including numerous resident native and introduced species, as well as several anadromous species. Although each fish species fulfills an ecological niche, several species are of primary management concern either as a result of their declining status or because of their importance as a recreational and/or commercial fishery. Steelhead is listed as "threatened" under the Federal ESA. Current recreationally and/or commercially important anadromous species include fall-run Chinook salmon, steelhead, striped bass, American shad, and Sacramento splittail.

Currently, the river supports a mixed run of hatchery and naturally produced fish. From 1967 through 1991 (the AFRP restoration goal baseline period), lower American River fall-run Chinook salmon spawning comprised approximately 21 percent (i.e., 41,040 fish) of the total fall-run Chinook salmon spawning (i.e., 197,740 fish) in the Sacramento Valley river system, including the Sacramento River and its tributary rivers and creeks.

The lower American River currently provides spawning and rearing habitat for fall-run Chinook salmon and steelhead below Nimbus Dam. The majority of the steelhead run is believed to be of hatchery origin. However, with the exception of an emergency release during January of 1997 resulting from poor water quality caused by flooding, no steelhead have been stocked directly into the lower American River since 1990 (Barngrover 1997).

Special-status[3] fish species within the lower American River include Central Valley steelhead, spring-run Chinook salmon, and fall-run/late-fall-run Chinook salmon. Central

[3] Special-status fish species are those having designated critical habitat and/or are listed, proposed for listing, or candidate species under the Federal or State Endangered Species Acts, a managed species under the MSFCMA, and/or a Federal or State species of concern.

Valley steelhead are listed as a threatened species under the Federal ESA and have no State ESA or CDFG status. The lower 10 miles of the American River has been designated as critical habitat for spring-run Chinook salmon. Fall-run/late fall-run Chinook salmon[4] is a Federal species of concern, and late fall-run Chinook salmon is considered a State species of special concern. Chinook salmon also is a federally managed fish species under the MSFCMA. Recreationally and/or commercially important anadromous species include fall-run Chinook salmon, steelhead, striped bass, and American shad. A variety of centrarchid species including black bass also are recreationally important.

Folsom Reservoir Folsom Reservoir has a maximum storage capacity of approximately 977,000 AF, and has a maximum depth of approximately 266 feet (streambed elevation at the main dam is about 200 feet). Strong thermal stratification occurs within Folsom Reservoir annually between April and November. Thermal stratification establishes a warm surface water layer (epilimnion), a middle water layer characterized by decreasing water temperature with increasing depth (metalimnion or thermocline), and a bottom, coldwater layer (hypolimnion) within the reservoir. In terms of aquatic habitat, the warm epilimnion of Folsom Reservoir provides habitat for warmwater fishes, whereas the reservoir's lower metalimnion and hypolimnion form a "coldwater pool" that provides habitat for coldwater fish species throughout the summer and fall portions of the year. Hence, Folsom Reservoir supports a "two-story" fishery during the stratified portion of the year (April through November), with warmwater species using the upper, warmwater layer and coldwater species using the deeper, colder portion of the reservoir.

Native species that occur in the reservoir include hardhead (*Mylopharodon conocephalus*) and Sacramento pikeminnow. However, introduced largemouth bass (*Micropterus salmoides*), smallmouth bass, spotted bass (*Micropterus punctulatus*), bluegill (*Lepomis macrochirus*), black and white crappie (*Pomoxis nigromaculatus* and *P. annularis*), and catfish (*Ictalurus* spp. and *Ameiurus* spp.) constitute the primary warmwater sport fisheries of Folsom Reservoir. The coldwater sport species present in the reservoir include rainbow and brown trout, kokanee salmon (*Oncorhynchus nerka*), and Chinook salmon, all of which are currently or have been stocked by CDFG. Although brown trout are no longer stocked, a population still remains in the reservoir. Because these coldwater salmonid species are stream spawners, they do not reproduce within Folsom Reservoir. However some spawning by one or more of these species may occur in the North Fork American River upstream of Folsom Reservoir.

Folsom Reservoir's coldwater pool is important not only to the reservoir's coldwater fish species identified above, but also is important to lower American River fall-run Chinook salmon and Central Valley steelhead. Seasonal releases from the reservoir's coldwater pool provide thermal conditions in the lower American River that support annual in-river

[4] NMFS recognizes the late-fall-run Chinook salmon in the Central Valley fall-run Evolutionarily Significant Unit (ESU) (Moyle 2002). On April 15, 2004, NMFS published a notice in the Federal Register acknowledging establishment of a species of concern list, addition of species to the species of concern list, description of factors for identifying species of concern, and revision of the candidate species list. In this notice, NMFS announced the Central Valley Fall-run and Late Fall-run Chinook Salmon ESU change in status from a candidate species to a species of concern. In 1999, the Central Valley ESU underwent a status review after NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under the ESA, but sufficient concerns remained to justify addition to the candidate species list. Therefore, according to NMFS' April 15, 2004 interpretation of the ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

production of these salmonid species. However, Folsom Reservoir’s coldwater pool is not large enough to facilitate coldwater releases during the warmest months (July through September) to provide maximum thermal benefits to over-summering juvenile steelhead rearing in the lower American River, and coldwater releases during October and November that would maximally benefit fall-run Chinook salmon immigration, spawning, and embryo incubation. Consequently, management of the reservoir’s coldwater pool on an annual basis is essential to providing thermal benefits to both fall-run Chinook salmon and steelhead, within the constraints of coldwater pool availability.

Lake Natoma Lake Natoma supports many of the same fisheries found in Folsom Reservoir (rainbow trout, bass, sunfish, and catfish). Some recruitment of warmwater and coldwater fishes likely comes from Folsom Reservoir. In addition, CDFG stocks Lake Natoma with catchable-sized rainbow trout annually. Although supporting many of the same fish species found in Folsom Reservoir, Lake Natoma’s limited primary and secondary production, colder epilimnetic water temperatures (relative to Folsom Reservoir), and daily elevation fluctuations are believed to reduce the size and annual production of many of its fish populations, relative to Folsom Reservoir (USFWS 1991). Lake Natoma's characteristics, coupled with limited public access, result in its lower angler use compared to Folsom Reservoir.

Lake Natoma was constructed to serve as a regulating afterbay for Folsom Reservoir and is located at an elevation of 132 feet above msl. Despite its size (an operating range of 2,800 AF), Lake Natoma can influence the temperature of water flowing through it. High residence times in the lake, particularly during summer months, have a warming effect on water released from Folsom Reservoir. Water is released from Lake Natoma into the lower American River below Nimbus Dam.

Nimbus Fish Hatchery CDFG, under contract with Reclamation, operates the Nimbus Salmon and Steelhead Hatchery and the American River Trout Hatchery, which produce anadromous fall-run Chinook salmon and steelhead, and non-anadromous rainbow trout, respectively. Both of these hatcheries are located at the same facility immediately downstream of Nimbus Dam. Each year, nearly four million salmon produced by the Nimbus Hatchery are trucked and released into the Sacramento River-San Joaquin Estuary. Steelhead are released into the Sacramento River at either Miller Park or Garcia Bend. Trout are stocked in numerous water bodies throughout the region.

The Nimbus Hatchery receives water for its operations directly from Lake Natoma via a 60-inch-diameter pipeline. Water temperatures in the hatchery are dictated by the temperature of water diverted from Lake Natoma, which in turn, is primarily dependent upon several factors including the temperature of water released from Folsom Reservoir, ambient air temperature, and retention time in Lake Natoma. The temperature of water diverted from Lake Natoma for hatchery operations is frequently higher than that which is generally desired for hatchery production of salmonids. Under such conditions, more suitable water temperatures may be achieved by increasing releases at Folsom Dam and/or releasing colder water from a lower elevation within Folsom Reservoir. However, seasonal releases from Folsom Reservoir's limited coldwater pool to benefit hatchery operations must be considered in conjunction with seasonal in-river benefits from such releases.

Sacramento River

The upper Sacramento River is often defined as the portion of the river from Princeton (RM 163) (the downstream extent of salmonid spawning in the Sacramento River (Water Forum 1999) to Keswick Dam (the upstream extent of anadromous fish migration and spawning). The upper Sacramento River provides a diversity of aquatic habitats, including fast-water riffles and shallow glides, slow-water deep glides and pools, and off-channel backwater habitats. Consequently, this section of the river is of primary importance to native anadromous species, and is presently utilized for spawning and early-life-stage rearing, to some degree, by all four runs of Chinook salmon (fall, late-fall, winter, and spring runs) and steelhead.

The lower Sacramento River is generally defined as the portion of the river from Princeton to the Delta at approximately Chipps Island (near Pittsburg). The lower Sacramento River is predominantly channelized, leveed and bordered by agricultural lands. Aquatic habitat in the lower Sacramento River is characterized primarily by slow-water glides and pools, is depositional in nature, and has lower water clarity and habitat diversity, relative to the upper portion of the river.

Many of the fish species utilizing the upper Sacramento River also use the lower river to some degree, even if only as a migratory pathway to and from upstream spawning and rearing grounds. For example, adult Chinook salmon and steelhead primarily use the lower Sacramento River as an immigration route to upstream spawning habitats and an emigration route to the Delta. The lower river also is used by other fish species (e.g., Sacramento splittail and striped bass) that make little to no use of the upper river (upstream of RM 163). Overall, fish species composition in the lower portion of the Sacramento River is quite similar to that of the upper Sacramento River and includes resident and anadromous cold- and warmwater species. Many fish species that spawn in the Sacramento River and its tributaries depend on river flows to carry their larval and juvenile life stages to downstream nursery habitats. Native and introduced warmwater fish species primarily use the lower river for spawning and rearing, with juvenile anadromous fish species also using the lower river and non-natal tributaries, to some degree, for rearing.

Over 30 species of fish are known to use the Sacramento River. Of these, a number of both native and introduced species are anadromous. These species include Chinook salmon, steelhead, green and white sturgeon, striped bass and American shad. The majority of adult immigration into the Sacramento River and the subsequent period of holding occurs from December through July for winter-run Chinook salmon (Moyle 2002; USFWS 1995), from February through September for spring-run Chinook salmon (CDFG 1998; Lindley et al. 2004; Moyle 2002) from July through December for fall-run Chinook salmon (NMFS 2004; Snider et al. 1999; Vogel and Marine 1991), from October through April for late fall-run Chinook salmon (Moyle 2002), and from August through March for steelhead (McEwan 2001; NMFS 2004).

Most winter-run sized Chinook salmon fry and juveniles collected in an rotary screw trap located at RM 205 have been captured from July through April (pers. comm., Coulon 2004). However, NMFS (1993; 1997) reports juvenile rearing and outmigration extending from June through April. CDFG (1998) and Moyle (2002) report that spring-run Chinook salmon juveniles rear and move downstream year-round in the Sacramento River. Moyle (2002) and

Vogel and Marine (1991) report that the majority of the juvenile rearing and downstream movement life stage occur from December through June for fall-run Chinook salmon and April through December for late fall-run Chinook salmon. McEwan (2001) reports that steelhead fry and fingerlings rear and move downstream in the Sacramento River year-round. Most steelhead smolts reportedly emigrate from January through June (McEwan 2001; Newcomb and Coon 2001; Snider and Titus 2000a; USFWS 1995a). Other Sacramento River fishes are considered resident species, which complete their lifecycles entirely within freshwater, often in a localized area. Resident species include rainbow and brown trout, largemouth and smallmouth bass, channel catfish, sculpin, Sacramento pikeminnow, Sacramento sucker, hardhead, and common carp (Moyle 2002).

Adult striped bass are present in the Sacramento River throughout the year, with peak abundance occurring during the spring months (i.e., April through June) (CDFG 1971; DeHaven 1977; DeHaven 1978). In the Sacramento River, most striped bass spawning is believed to occur between Colusa and the mouth of the Feather River.

The Yolo and Sutter bypasses, floodwater bypasses from the Sacramento River, serve as important Sacramento splittail spawning and early rearing habitat (Sommer et al. 1997). Sacramento splittail spawning can occur anytime between late February and early July but peak spawning occurs in March and April (Moyle 2002). A gradual upstream migration begins in the winter months to forage and spawn, although some spawning activity has been observed in Suisun Marsh (Moyle 2002). Eggs normally incubate for three to seven days depending on water temperature (Moyle 2002). After hatching, splittail larvae remain in shallow weedy areas until water recedes, and they migrate downstream (Meng and Moyle 1995). Downstream movement of juvenile splittail appears to coincide with drainage from the floodplains between May and July (Caywood 1974; Meng and Moyle 1995; Sommer et al. 1997).

Shasta Reservoir Thermal stratification, which occurs in Shasta Reservoir annually between April and November, establishes a warm surface water layer, a middle water layer characterized by decreasing temperature with increasing depth, and a bottom, coldwater layer within the reservoir. Shasta Reservoir supports a “two-story” fishery during the stratified portion of the year, with coldwater fish species using the deeper, colder portion of the reservoir and warmwater fish species using the upper, warm-water layer. Fish inhabiting the reservoir include several species of trout, kokanee salmon, Sacramento sucker, Sacramento pikeminnow, largemouth and smallmouth bass, channel catfish, white catfish, threadfin shad, and common carp.

Keswick Reservoir Keswick Reservoir is characterized as a coldwater impoundment that supports a rainbow and brown trout sport fishery. Keswick Dam is a complete barrier to the upstream migration of anadromous fishes in the Sacramento River. Some of the migrating anadromous fish impeded by Keswick Dam are captured in a fish trap at the dam and are transported to the Coleman National Fish Hatchery located on Battle Creek (southeast of the town of Anderson).

Sacramento–San Joaquin Delta

The Sacramento-San Joaquin Delta, the most upstream portion of the Bay-Delta estuary, is a triangle-shaped area composed of islands, river channels, and sloughs at the confluence of the Sacramento and San Joaquin rivers. The northern Delta is dominated by the waters of the Sacramento River, which are of relatively low salinity; whereas the relatively higher salinity waters of the San Joaquin River dominate the southern Delta. The central Delta includes many channels where waters from the Sacramento and San Joaquin rivers and their tributaries converge. The Delta includes the river channels and sloughs at the confluence of the Sacramento and San Joaquin rivers.

The Delta's tidally influenced channels and sloughs cover a surface area of approximately 75 square miles. Data suggest that these intertidal waters favor a number of resident freshwater fish and invertebrate species at the deepest, most subsided sites. Marsh plains and tidal channels formed within these intertidal regions continuously drain and fill with the ocean tide allowing movement of fishes, in addition to primary and secondary production, inshore and offshore. Therefore, tidal action may be important for pelagic organisms as inundation allows increased foraging success and opportunity resulting from the larger abundance of phytoplankton and zooplankton inshore. Intertidal habitats may also provide reduced predation for young fishes (Brown 2003). These waters may also be used as migration corridors and rearing areas for anadromous fish species and as spawning and rearing grounds for many estuarine species. Similarly to intertidal regions, shallow-water habitats, defined as areas that are less than three meters in depth (mean low water), are considered particularly important forage, reproduction, rearing, and refuge areas for numerous fish and invertebrate species.

The Bay-Delta estuary provides habitat for a diverse assemblage of fish and macroinvertebrates. Many of the fish and macroinvertebrate species inhabit the estuary year-round, while other species inhabit the system on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing.

There have been over 100 documented introductions of exotic species to the Bay-Delta estuary. These include intentionally introduced game fishes such as striped bass and American shad, and inadvertent introductions of undesirable organisms such as Asiatic clams. **Table 3-4** presents common and scientific names for all known native and exotic fish species found in the Delta, including species no longer present.

Table 3-4. Fishes of the Sacramento-San Joaquin Delta

Common Name	Scientific Name	Life History	Status
Pacific lamprey*	Lampetra tridentata	A	Declining
River lamprey*	Lampetra ayresi	A	SC
White sturgeon*	Acipenser transmontanus	A	Declining; fishery
Green sturgeon*	Acipenser medirostris	A	SC; FT
American shad	Alosa sapidissima	A	Fishery
Threadfin shad	Dorosoma petenense	A	Common
Steelhead*	Oncorhynchus mykiss	A	SC; FT; fishery
Brown Trout	Salmo trutta	R	Non-native
Chum salmon*	*Oncorhynchus keta*	A	SC; rare
Kokanee salmon	*Oncorhynchus nerka*	R	Non-native
Chinook salmon*	*Oncorhynchus tshawytscha*	A	Fishery

Table 3-4. Fishes of the Sacramento-San Joaquin Delta (continued)

Common Name	Scientific Name	Life History	Status
Sacramento fall-run			Fishery
late fall-run			SC
winter-run			FE, SE
Sacramento fall-run (cont.)			Fishery
spring-run			ST; FT
Longfin smelt*	Spirinchus thaleichthys	A-R	SC
Delta smelt*	Hypomesus transpacificus	R	FT, ST
Wakasagi	Hypomesus nipponensis	R?	Invading
Hitch*	Lavinia exilicauda	R	Unknown
Sacramento blackfish*	Orthodon microlepidotus	R	Unknown
Sacramento splittail*	Pogonichthys macrolepidotus	R	SC
Hardhead*	Mylopharodon conocephalus	N	SC
Speckled dace	Rhinichthys osculus	R	SC
California roach	Lavinia symmetricus	R	SC
Sacramento pikeminnow*	Ptychocheilus grandis	R	Common
Fathead minnow	Pimephales promelas	N	Rare
Golden shiner	Notemigonus crysoleucas	R?	Uncommon
Common carp	Cyprinus carpio	R	Common
Goldfish	Carassius auratus	R	Uncommon
Sacramento sucker*	Catostomus occidentalis	R	Common
Black bullhead	Ameiurus melas	R	Common
Brown bullhead	Ameiurus nebulosus	R	Uncommon
White catfish	Ameiurus catus	R	Abundant
Channel catfish	Ictalurus punctatus	R	Common
Western mosquitofish	Gambusia affinis	R	Abundant
Striped bass	Morone saxatilis	R-A	Abundant
Inland silverside	Menidia beryllina	R	Abundant
Sacramento perch*	Archoplites interruptus	N	SC
Bluegill	Lepomis macrochirus	R	Common
Redear sunfish	Lepomis microlophus	R	Uncommon
Green sunfish	Lepomis cyanellus	R	Uncommon
Warmouth	Lepomis gulosus	R	Uncommon
White crappie	Pomoxis annularis	R	Common
Black crappie	Pomoxis nigromaculatus	R	Uncommon
Largemouth bass	Micropterus salmoides	R	Common
Smallmouth bass	Micropterus dolomieu	R	Uncommon
Redeye bass	Micropterus coosae	R	Non-native
Spotted Bass	Micropterus punctulatus	R	Non-native
Bigscale logperch	Percina macrolepida	R	Common
Yellow perch	Perca flavescens	N	Rare
Tule perch*	Hysterocarpus traski	R	Common
Threespine stickleback*	Gasterosteus aculeatus	R	Common
Yellowfin goby	Acanthogobius flavimanus	R	Common
Chameleon goby	Tridentiger trigonocephalus	R	Invading
Staghorn sculpin*	Leptocottus armatus	M	Common
Prickly sculpin*	Cottus asper	R	Abundant
Starry flounder*	Platichthys stellatus	M	Common

Source: Modified from (USFWS, 1994 as cited in SDIP (Reclamation and DWR 2005)

An asterisk (*) indicates a native species; A = anadromous; R = resident; N = non-resident visitor; M = marine; SC = species of special concern; FT = Federal threatened; ST = State threatened; FE = Federal endangered; SE = State endangered

Migratory (e.g., anadromous) fish species which inhabit the Bay-Delta system and its tributaries include, but are not limited to, white sturgeon, green sturgeon, Chinook salmon (including fall-run, spring-run, winter-run, and late-fall-run Chinook salmon), steelhead, American shad, Pacific lamprey, and river lamprey (Moyle 2002). The Bay-Delta estuary and tributaries also support a diverse community of resident fish which includes, but is not limited to, Sacramento sucker, prickly and riffle sculpin, California roach, hardhead, hitch, Sacramento blackfish, Sacramento pikeminnow, speckled dace, Sacramento splittail, tule perch, inland silverside, black crappie, bluegill, green sunfish, largemouth bass, smallmouth bass, white crappie, threadfin shad, carp, golden shiner, black and brown bullhead, channel catfish, white catfish, and a variety of other species which inhabit the more estuarine and freshwater portions of the Bay-Delta system (Moyle 2002).

The geographic distribution of species within the estuary is determined, in part, by salinity gradients, which range from freshwater within the Sacramento and San Joaquin River systems to marine conditions near the Golden Gate Bridge. The abundance, distribution, and habitat use by these fish and macroinvertebrates has been monitored over a number of years through investigations conducted by CDFG, NMFS, USFWS, Reclamation, and several other investigators. Results of these monitoring programs have shown changes in species composition and abundance within the system over the past several decades. Many of the fish and macroinvertebrate species have experienced generally declining trends in abundance (Moyle et al. 1995) with several native species, including winter-run and spring-run Chinook salmon, steelhead, and delta smelt either listed or being considered for listing under the Federal ESA or State ESA. A number of fish and macroinvertebrate species inhabiting the estuary also support recreational and commercial fisheries, such as fall-run Chinook salmon, Bay shrimp, Pacific herring, northern anchovy, starry flounder, striped bass, largemouth bass, sturgeon, and many others, and hence the estuary also has been identified as essential fish habitat (EFH) for many of these species.

Many factors have contributed to the decline of fish species within the Delta (Moyle et al. 1995), including changes in hydrologic patterns resulting from water project operations, loss of habitat, contaminant input, entrainment in diversions, and introduction of non-native species. The Delta is a network of channels through which water, nutrients, and aquatic food resources are moved and mixed by tidal action. Pumps and siphons divert water for Delta irrigation and municipal and industrial use or into CVP and SWP canals. River inflow, Delta Cross Channel operations, and diversions (including agricultural and municipal diversions and export pumping) affect Delta species through changes in habitat conditions (e.g., salinity intrusion), and mortality attributable to entrainment in diversions. Since 2002, routine fish surveys have registered sharp declines in several pelagic (open-water) species, including the delta smelt, a species listed as a threatened species under the Federal and State Endangered Species Acts.

Interagency Ecological Program (IEP) surveys also have observed record low abundances for striped bass, and near record lows for longfin shad and threadfin shad (IEP 2007). Subsequent surveys in 2006 and 2007 have confirmed this trend, raising concerns that the delta smelt, which is seen as an indicator of ecosystem health in the Delta, risks extinction if a solution is not found quickly (Public Policy Institute of California 2007). Several hypotheses have been put forward to potentially explain the reason behind the recent changes in Delta conditions and species declines, and multiple factors are currently being investigated by a combination of Federal, State, and academic researchers.

In response to these concerns about the current status of the Delta, other planning efforts also are under way, including the Delta Vision process, launched by the Governor in fall 2006. The Delta Vision is intended to identify a strategy for managing the Delta as a sustainable ecosystem that would continue to support environmental and economic functions that are critical to the people of California. Although it builds on work done through the CALFED Bay-Delta Program, the Delta Vision will broaden the focus of past efforts within the Delta to recommend actions that will address the full array of natural resource, infrastructure, land use and governance issues necessary to achieve a sustainable Delta (CALFED Website 2007). The Delta Vision (DWR 2007) is based on a growing consensus among scientists, supported by recent legislation and other information, indicating that:

- Environmental conditions and current Delta “architecture” are not sustainable;
- Current land and water uses and related services dependent on the Delta are not sustainable based on current management practices and regulatory requirements;
- Current environmental conditions and current and ongoing services (e.g., utility, transportation and water conveyance services) are reliant on an aging and deteriorating levee system;
- Major "drivers of change" that are largely outside of our control will impact the Delta during the coming decades, including seismic events, land subsidence, sea level rise, regional climate change and urbanization;
- The current fragmented and complex governance systems within the Delta are not conducive to effective management of the fragile Delta environment in the face of the cumulative threats identified above; and
- Failure to act to address identified Delta challenges and threats will result in potentially devastating environmental and economic consequences of Statewide and national significance.

This environmental assessment acknowledges that there are numerous issues surrounding the Delta, and recognizes that, in response to these planning efforts, future Delta operations and management will differ from that which has been in place under the NEPA Affected Environment.

Tracy Fish Collection Facility

Fish salvage facilities at the Jones Pumping Plant are composed of a system of primary and secondary louvers (Brown and Greene 1992 *as cited in* DWR and Reclamation 1996a). Four bypasses placed equidistantly along the screen face direct fish from the primary louvers to a secondary set of louvers, where they are concentrated and bypassed to holding tanks. Salvaged fish are periodically transferred by truck to a release point in the Delta.

The pumps at Jones Pumping Plant are usually operated continuously, and because water is drawn directly from the Delta, pumping is subject to tidal influence, causing variation in channel velocity and approach velocities to fish screens (Brown and Greene 1992 *as cited in* DWR and Reclamation 1996a). In 1998, Reclamation published a report concerning fish collections and secondary louver efficiency from October 1993 to September 1995 at the Tracy Fish Collecting Facility (TFCF). The objectives of this study were to identify the fish populations moving through the secondary louvers and into the fish holding tanks (as a percent compared to the number of fish entering the channel), in addition to evaluating the efficiency of the secondary louvers relative to environmental and operational parameters. During the evaluation only two delta smelt were caught, while splittail was the species most routinely observed. The report concluded that the entrainment susceptibilities of several species are largely dependent on seasonal variation, suggesting that life history is associated with screen entrainment at the TFCF for species such as splittail and Chinook salmon. The mean efficiency for Chinook salmon was found to be 83 percent, the efficiency for white catfish to be 89 percent, the efficiency for splittail to be 63 percent, and the efficiency for striped bass to be 86 percent. However, screen efficiency may be lower since the facilities reconstruction (Reclamation 1998). Entrainment for American shad was most likely to occur during May through December when young American shad were moving downstream. In addition, American shad are two or more times more likely to move through the louvers during the day than at night. CDFG conducted efficiency tests on the primary louver system, which revealed that striped bass longer than 24 mm were effectively screened and bypassed. Similar results were observed for striped bass by Reclamation with an average screened fork length of 116 mm. However, planktonic eggs, larvae, and juveniles less than 24 mm in length received no protection from entrainment (Hallock et al. 1968 *as cited in* DWR and Reclamation 1996a). The tests also indicated that juvenile Chinook salmon would be effectively screened because they would be greater than 24 mm in length by the time they were exposed to the screens and pumps. Screening efficiency for delta smelt has yet to be determined.

John E. Skinner Fish Facility

The John E. Skinner Fish Facility includes primary and secondary louvers (screens) designed to guide fish to bypass and salvage facilities before they are drawn into the Banks Pumping Plant (Brown and Greene, 1992 *as cited in* (DWR and Reclamation 1996a). The primary fish screens are composed of a series of V-shaped bays containing louver systems resembling Venetian blinds that act as a behavioral barrier to fish. The secondary fish screen is a perforated plate, positive-pressure screen, which removes fish greater than about 20 mm in length. Salvaged fish are transported in trucks to one of several Delta release sites. Despite recent improvements in salvage operations, survival of species that are more sensitive to handling, such as delta smelt, is believed to be low (DWR and Reclamation 1994 *as cited in* (DWR and Reclamation 1996a).

The fish screening and salvage facilities began operating in 1968. In the early 1970s, CDFG and DWR initiated extensive evaluations of the facility that have led to improved performance and reduced fish losses. Most of this effort focused on fall-run Chinook salmon, striped bass, and American shad.

DWR conducts daily fish monitoring and fish salvage operations at the SWP Skinner Fish Facility. As part of the monitoring program at the Skinner Fish Facility, operations are monitored and information recorded on water velocities that affect louver guidance efficiency for various species and life stages of fish, species composition, the occurrence of coded-wire tag (CWT) and other marked fish released as part of experimental investigations, the length-frequency distribution for various species, and other information used to evaluate and monitor fish salvage operations. Fish entering the salvage facilities are subsampled, identified and measured, and subsequently returned to the Delta through a trucking and release operation. The numbers of various fish species salvaged at the SWP Skinner Fish Facility and CVP Tracy Fish Facility show high variability on a seasonal basis and between years, reflecting variation in both the life history characteristics of many of the species and their vulnerability to salvage at the facility.

In general, the majority of juvenile Chinook salmon (primarily fall-run Chinook salmon) are observed in salvage operations during the late winter and early spring (February through May), although juvenile salmonids are also observed during the late fall and winter (November through January), which may include yearling spring-run and fall-run salmon, late-fall-run salmon smolts, and pre-smolt winter-run juvenile salmon. Steelhead are primarily observed in salvage during the spring months (March and April), which is consistent with the general seasonal timing for steelhead smolt out migration. Striped bass are observed in salvage operations throughout the year, with the majority of juvenile striped bass occurring during the summer months (May through July). Similarly, delta smelt are observed in the salvage operations throughout the year, with the majority of juvenile delta smelt occurring during the late spring and early summer (May through July). Larger sub-adult and adult delta smelt are typically observed in the salvage operation more predominantly during the fall, winter, and early spring. Longfin smelt are primarily observed in the salvage operations during the spring (March through May) as juveniles, although larger sub-adult longfin smelt are also observed in the salvage operations during the fall. Sacramento splittail are also observed in salvage operations throughout the year, although the majority of splittail (young-of-the-year) occur during the spring and early summer (March through July). A variety of other resident and migratory fish species are also collected as part of both CVP and SWP salvage operations.

Combined Downstream Effects of the CVP and SWP Facilities

Local effects of the CVP facilities on fish, such as export losses and Cross Channel and Georgiana Slough diversions, are included in the above discussions of the facilities. In addition to these effects, the CVP facilities also influence downstream habitat conditions. These conditions include Delta outflow, salinity levels in the western Delta and the bays, the location of X2, and the levels of flow reversals in the lower San Joaquin River.

Delta Outflow Water development has changed the volume and timing of freshwater flows through the Bay-Delta estuary. Each year, diversions reduce the volume of fresh water that otherwise would flow through the estuary (CALFED 2000). During this century, the volume of the estuary's fresh water supply that has been depleted each year by upstream diversions, in-Delta use, and Delta exports have grown from about 1,500,000 AF to nearly 16,000,000 AF. As a result, the proportion of Delta outflow depleted by upstream and Delta diversions has grown substantially.

Water development has also greatly altered seasonal flows into and through the estuary. Flows have decreased substantially in April, May, and June and have increased slightly during the summer and fall (USEPA 1992). Seasonal flows influence the transport of eggs and young organisms through the Delta and into San Francisco Bay. Flows during the months of April, May, and June play an especially important role in the reproductive success and survival of many estuarine species including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983; Stevens et al. 1985; Herbold 1994; Meng and Moyle 1995).

Salinity In many segments of the estuary, and particularly in Suisun Bay and the Delta, salinity is controlled primarily by freshwater flow. By altering the timing and volume of flows, water development has affected salinity patterns in the Delta and parts of San Francisco Bay (SFEP 1992 as cited *in* DWR and Reclamation 1996a).

Under natural conditions, the Carquinez Strait/Suisun Bay area marked the approximate boundary between salt and fresh water in the estuary during much of the year. In the late summer and fall of drier years, when Delta outflow was minimal, seawater moved into the Delta from San Francisco Bay. Beginning in the 1920s, following several dry years and because of increased upstream storage and diversions, salinity intrusions became more frequent and extensive.

Since the 1940s, releases of fresh water from upstream storage facilities have increased Delta outflows during summer and fall. These flows have correspondingly limited the extent of salinity intrusion into the Delta. Reservoir releases have helped to ensure that the salinity of water diverted from the Delta is acceptable during the summer and late fall for farming, municipal, and industrial uses (SFEP 1992 *as cited in* DWR and Reclamation 1996a).

Salinity is an important habitat factor in the estuary. Estuarine species characteristically have optimal salinity ranges, and their survival may be affected by the amount of available habitat within the species' optimal salinity range. Because the salinity field in the estuary is largely controlled by freshwater outflows, the level of outflow may determine the surface area of optimal salinity habitat that is available to the species (Hieb and Baxter 1993; Unger 1994).

Entrapment Zone Location and X2 The entrapment zone is an area of the estuary characterized by higher levels of particulates, higher abundances of several types of organisms, and maximal turbidity. It is commonly associated with the position of the 2 ppt salinity isopleth (X2), but actually occurs over a broader range of salinities (Kimmerer 1992). Originally, the primary mechanism responsible for this area was thought to be gravitational circulation, a circulation pattern formed when freshwater flows seaward over a dense, landward-flowing marine tidal current. However, recent studies have shown that gravitational circulation does not occur in the entrapment zone in all years, nor is it always associated with X2 (Reclamation et al. 1995 *as cited in* DWR and Reclamation 1996a). Lateral circulation within the estuary and chemical flocculation may play roles in the formation of the turbidity maximum of the entrapment zone.

As a consequence of higher levels of particulates, the entrapment zone may be biologically significant to some species. Mixing and circulation in this zone concentrates plankton and other organic material, thus increasing food biomass and production. Larval fish such as striped bass, delta smelt, and longfin smelt may benefit from enhanced food resources. Since about 1987, however, the introduced Asian clam population has reduced much of the primary production in the estuary and there has been virtually no enhancement of phytoplankton production or biomass in the entrapment zone (CUWA 1994 *as cited in* DWR and Reclamation 1996a).

Although little to no enhancement of the base of the food chain in the entrapment zone may have occurred during the past decade, this area continues to have relatively high levels of invertebrates and larval fish. Vertical migration of these organisms through the water column at different parts of the tidal cycle has been proposed as a possible mechanism that is maintaining high abundances in this area, but recent evidence suggests that vertical migration does not provide a complete explanation (Kimmerer 1992).

Although recent evidence indicates that X2 and the entrapment zone are not as closely related as previously believed (Reclamation et al. 1995; DWR and Reclamation 1996a), X2 continues to be used as an index of the location of the entrapment zone or area of increased biological productivity. Historically, the location of X2 has varied between San Pablo Bay (RK 50) during high Delta outflow and Rio Vista (RK 100) during low Delta outflow. In recent years, it has typically been located between approximately Honker Bay and Sherman Island (River km 70 to 85). X2 is controlled directly by the rate of Delta outflow, although changes in X2 lag behind changes in outflow. Minor modifications in outflow do not greatly alter the X2 location. The location of X2 during the late winter through spring (February through June) is included as a water quality objective in the 1995 Bay/Delta Water Quality Control Plan.

Jassby et al. (1995) showed that when X2 is in the vicinity of Suisun Bay, several estuarine organisms tend to show increased abundances. owever, it is by no means certain that X2 has a direct effect on any of the species. The observed correlations may result from a close relationship between X2 and other factors that affect these species.

San Luis Reservoir

San Luis Reservoir provides habitat for both coldwater and warmwater fish species which include largemouth bass, striped bass, crappie, bluegill, bullhead catfish, shad, yellow perch and occasional white sturgeon (California State Parks Website 2003). Fish production in San Luis Reservoir is generally limited by changes in water elevations during critical spawning periods, overall reservoir levels, and the availability of shallow near-shore rearing habitat. Stocking by CDFG keeps the reservoir well supplied with trout. Bass fishing derbies are often held here, and crappie and bluegill are also caught.

3.5.3 Regulatory Setting

Federal Endangered Species Act

The ESA requires that both USFWS and NMFS maintain lists of threatened species and endangered species. An “endangered species” is defined as “…any species which is in danger of extinction throughout all or a significant portion of its range.” A “threatened species” is defined as“…any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 USC 1532). Section 9 of the ESA makes it illegal to “take” (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) any endangered species of fish or wildlife, and regulations contain similar provisions for most threatened species of fish and wildlife (16 USC 1538).

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each Federal agency must consult with USFWS or NMFS, or both, if the Federal agency determines that its action might impact a listed species. NMFS jurisdiction under the ESA is limited to the protection of marine mammals and fishes and anadromous fishes; all other species are within USFWS jurisdiction.

Critical Habitat Critical habitat for listed species consists of (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of Section 4 of the Endangered Species Act, on which are found those physical or biological features (constituent elements0 (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provision of Section 4 of the Act, upon a determination by the Secretary of the Department of the Interior that such areas are essential for the conservation of the species.

Essential Fish Habitat Section 305(b)(2) of the 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) added a provision for Federal agencies to consult with National Marine Fisheries Service (NMFS) on impacts to EFH. EFH only applies to Chinook salmon habitat that includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding, or growing to maturity. Consultation on any activity that might adversely affect EFH is required by NMFS under the MSFCMA, as amended by the Sustainable Fisheries Act of 1996. EFH includes all habitats necessary to allow the production of commercially valuable aquatic species, to support a long-term sustainable fishery, and contribute to a healthy ecosystem.

Central Valley Project Improvement Act and Anadromous Fish Restoration Program

The CVPIA (Title 34 of P.L. 102-575) amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water. It also elevates fish and wildlife enhancement to a level having equal purpose with power generation.

The CVPIA identifies several goals to meet these new purposes. Significant among these is the broad goal of restoring natural populations of anadromous fish, green and white sturgeon American shad, and striped bass in Central Valley rivers and streams to double their recent average levels.

Section 3406(b)(1) jointly imparted the responsibilities of implementing the CVPIA to the USFWS and Reclamation, although the USFWS has assumed the lead role in the development of the AFRP. The Final Restoration Plan for the AFRP was adopted on January 9, 2001 and will be used to guide the long-term development of the AFRP. Additionally, under USFWS direction, technical teams have assisted in the establishment of components of the AFRP. A key element of the program is instream flow recommendations, including objectives for the lower American River and upper Sacramento River.

Long-Term Central Valley Project and State Water Project Operations Criteria and Plan

The Long-Term CVP and SWP OCAP serves as the operational standard by which Reclamation operates the integrated CVP/SWP system. The OCAP describes how Reclamation and DWR operate the CVP and the SWP to divert, store, and convey water consistent with applicable law (Reclamation 2004). Reclamation and DWR completed an update to the OCAP in 2004 to reflect recent operational and environmental changes occurring throughout the CVP/SWP system. Additionally, Reclamation received BOs from both the USFWS and NMFS in 2004. The terms and conditions identified in the USFWS and NMFS BOs establish the instream habitat conditions and operational requirements that Reclamation and DWR must maintain as part of integrated CVP/SWP operations. Both USFWS and NMFS BOs were declared to be incomplete and unlawful by the Federal court. USFWS and NMFS are in the process of completing new BOs and in the interim the CVP is operating under the 2004 BOs with additional court ordered operational constraints to protect the endangered and threatened species. The new BOs are expected to be completed this winter.

CALFED Bay-Delta Program
The CALFED Program is a collaborative effort of 23 Federal and State agencies focusing on restoring the ecological health of the Bay-Delta Estuary while ensuring water quality improvements and water supply reliability to all users of the Bay-Delta water resources (CALFED 2000b). The CALFED Program includes a range of balanced actions that can be taken forward to a comprehensive, multi-agency approach to managing Bay-Delta resources. The Bay-Delta watershed includes the Sacramento and San Joaquin rivers and tributaries (e.g., Feather and lower American rivers).

Environmental Water Account
The Environmental Water Account (EWA), as described in the CALFED ROD, is a key component of CALFED’s water management strategy. Created to address the problems of declining fish populations and water supply reliability, the EWA is an adaptive management tool that aims to protect both fish and water users as it modifies water project operations in the Bay-Delta. The EWA provides water for the protection and recovery of fish beyond that which would be available through the existing baseline of regulatory protection related to project operations. The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers and releases it as needed to protect fish and compensate water users for deferred diversions (USFWS 2004b). Recently, Reclamation and DWR, along with the CDFG, USFWS, and NMFS, prepared the Final Supplemental Environmental Impact Statement/ Environmental Impact Report (SEIS/EIR) covering the proposed extended operation of the CALFED Bay-Delta Program’s EWA from 2008 through 2011.

To date, EWA actions taken to benefit at-risk native fish species range from CVP/SWP export pumping curtailments, which directly reduce incidental take at the CVP and SWP pumps in the South Delta, to augmenting instream flows and Delta outflows. Beneficial changes in SWP and CVP operations could include changing the timing of water exports from Delta pumping plants to coincide with periods of greater or lesser vulnerability of various fish species to environmental conditions in the Delta. For example, EWA or its functional equivalent might alter the timing of water diversions from the Delta and carry out water transfers to reduce fish entrainment at the pumps and provide for migratory cues for specific anadromous fish species.

3.6 Terrestrial and Riparian Resources

This section describes the existing conditions of terrestrial and riparian resources and consists of (1) identification of communities and associated special-status plant and wildlife species with the potential to occur in the Action Area; and (2) documentation of the regulatory setting guiding terrestrial and riparian resources in the Action Area.

3.6.1 Environmental Setting

Middle Fork and North Fork American Rivers

The Middle Fork American River and lower North Fork American River flow through a variety of habitats as they pass from Ralston Afterbay to Folsom Reservoir. Habitats associated with this area include montane woodland and forests (mixed conifer and oak), montane riparian, upland scrub, urban-agriculture, montane riverine aquatic, and non-tidal freshwater permanent emergent wetlands. Montane woodlands and forests are predominantly ponderosa pine (*Pinus ponderosa*) forests. At least 238 species of birds, 47 mammals, 10 amphibians, and 20 species of reptiles are supported by the American River Canyon ecosystem and its habitats.

French Meadows and Hell Hole Reservoirs Higher elevations along the Middle Fork American River display montane woodlands and forests (mixed conifer (*Pinus* spp. and *Pseudotsuga menziesii*), oak (*Quercus* spp.), and montane hardwoods). Developed areas exist at the dams, public boat launches, and campgrounds on these reservoirs. Fluctuations in reservoir water surface elevations create a barren band around the reservoirs (i.e., the reservoir drawdown zone). These zones are essentially devoid of vegetation and therefore, do not provide valuable plant communities or animal habitats.

Folsom Reservoir and Lake Natoma

Habitats associated with Folsom Reservoir include non-native grassland, blue oak-pine woodland, and mixed oak woodland. Non-native grasslands occur around the reservoir, primarily at the southern end. The majority of the drawdown zone is devoid of vegetation. The only contiguous riparian vegetation occurs along Sweetwater Creek at the southern end of the reservoir (USFWS 1991). Because the drawdown zone is virtually devoid of vegetation and the sparse willows that have established in some areas do not form a contiguous riparian community, the drawdown zone does not possess substantial habitat value.

Oak-pine woodlands and non-native grasslands in the reservoir area support a variety of birds. A number of raptor species also utilize oak woodland habitats for nesting, foraging, and roosting. Many mammal species occur in the woodland. Amphibians and reptiles are found in oak woodlands.

The primary vegetation around Lake Natoma consists of cottonwoods, poison oak, and wild grape (*Vitis californica*). Vegetation surrounding the lake is subject to variable water levels that fluctuate several feet in elevation daily and weekly. Wildlife communities found at Lake Natoma are similar to those found at Folsom Reservoir.

Lower American River

The lower American River provides a diverse assemblage of vegetation communities, including freshwater marsh and emergent wetland, riparian scrub, riparian forest, and in the upper, drier areas farther away from the river, oak woodland and non-native grassland. The current distribution and structure of riparian communities along the river has been determined by human-induced changes such as gravel extraction, dam construction and operation, levee construction and maintenance, and historic and on-going streamflow and sedimentation processes. Because of these factors, several riparian vegetation zones exist along the banks of the lower American River.

In general, willow scrub and alder forest tend to occupy areas within the active channel of the lower American River, which are repeatedly disturbed by river flows. Cottonwood-willow thickets and cottonwood forests occupy the narrow belts along the active river channel where repeated disturbance by occasional high flows keep the vegetative communities at earlier successional stages.

Alder-cottonwood forest is typical of the steep, but moist banks along much of the river corridor. Valley oak woodland occurs on upper terraces composed of fine sediment where soil moisture provides a long growing season. Live oak woodland occurs in the more arid and gravelly terraces that are isolated from the fluvial dynamics and moisture of the river. Non-native grassland commonly occurs in areas that have been disturbed by human activity and can be found on many of the sites within the river corridor.

Backwater areas and off-river ponds that are recharged during high flows support emergent wetland vegetation. These habitat areas are located throughout the length of the river, but occur more regularly downstream of the Watt Avenue Bridge in Sacramento. Plant species that dominate this habitat type include various species of willow (*Salix* spp.), sedge (*Carex* spp.), cattail (*Typha* spp.), bulrush (*Scirpus* spp.), rush (*Juncus* spp.), barnyard grass (*Echinochloa crusgalli*), slough grass (*Paspalum dilatatum*), and lycopus (*Lycopus americanus*).

More than 220 species of birds have been recorded along the lower American River and more than 60 species are known to nest in the riparian habitats (USFWS 1991). Additionally, more than 30 species of mammals reside along the river. The most common reptiles and amphibians that depend on the riparian habitats along the river include western toad (*Bufo boreas*), Pacific tree frog (*Hyla regilla*), bullfrog (*Rana catesbeiana*), western pond turtle (*Clemmys marmorata*), western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), and gopher snake (*Pituophis catenifer*).

Sacramento River

Much of the Sacramento River is confined by levees that reduce the natural diversity of riparian vegetation. Agricultural land (rice, dry grains, pastures, orchards, vineyards, and row and truck crops) is common along the lower reaches of the Sacramento River, but is less common in the upper portions. The bands of riparian vegetation that occur along the Sacramento River are similar to that found along the lower American River, but are somewhat narrower and not as botanically diverse. The largest and most significant tract of riparian forest remaining on the Sacramento River is a stretch between Chico Landing and Red Bluff. Freshwater, emergent wetlands occur in the slow moving backwaters and are primarily (SAFCA and Reclamation, 1994). Although riparian vegetation occurs along the Sacramento River, these areas are confined to narrow bands between the river and the river side of the levee.

The wildlife species inhabiting the riparian habitats along the lower Sacramento River are essentially the same as those found along the lower American River. Mammals such as river otters and muskrats utilize riverine habitats for foraging and cover. Many amphibians and some reptiles (e.g., western pond turtles) inhabit riverine habitats for at least part of their life cycles. The freshwater/emergent wetlands represent habitat for many wildlife species, including reptiles and amphibians such as the western pond turtle, bullfrog, and Pacific tree frog. Agricultural areas adjacent to the river also represent foraging habitat for many raptor species.

Wildlife refuges along the Sacramento River provide habitat for resident and migratory waterfowl, threatened and endangered species, and wetland dependent aquatic biota. These refuges include the Sacramento, Colusa, Sutter, and Delevan National Wildlife Refuges (NWRs) and Gray Lodge Wildlife Management Area (WMA). Water supplies for certain wildlife refuges within the Central Valley are administered through CVPIA programs that acquire and convey water.

Shasta Reservoir Habitats associated with Shasta Reservoir include Douglas fir-Mixed Conifer forest, Mixed Conifer, Ponderosa Pine, Canyon Oak Woodland, Black Oak Woodland, Gray Pine Woodland and Chaparral. Plant species diversity is very high. The vegetative cover is best described as both complex and diverse. At lower elevations the vegetation consists of a mix of chaparral and hardwoods; mid-elevation slopes are within a transitional zone that contains both the chaparral/hardwood mix and a mixed conifer component; and higher elevation sites are dominated by mixed conifer overstory with brush species in the understory primarily in open areas. An exception to this trend is the Riparian Reserve corridor where conifers can span from lower to upper elevations.

Keswick Reservoir Habitats associated with Keswick Reservoir is very similar to Shasta Reservoir and include Douglas fir-Mixed Conifer forest, Mixed Conifer, Ponderosa Pine, Canyon Oak Woodland, Black Oak Woodland, Gray Pine Woodland and Chaparral.

Sacramento-San Joaquin Delta

Historically, the Delta supported extensive areas of saline and freshwater emergent marshes. Today, the Delta contains about 641,000 acres of agricultural land (72 percent of the total land area) that dominate its lowland areas. Hundreds of miles of waterways divide the Delta into islands, some of which are below sea level. The Delta has more than 1,000 miles of levees that protect these islands. Much of the freshwater and saline emergent marsh habitat formerly in the Delta has been lost as a result of urban and agricultural development, flood control, and water supply projects; however, some emergent marsh habitat, such as at Suisun Marsh, remain in the Delta. The remaining areas of emergent marsh provide important habitat for many resident and migratory species.

Most of the vegetation in the Delta consists of irrigated agricultural fields and associated ruderal (disturbed) non-native vegetation fringes that border cultivated fields. Throughout much of the Delta, these areas border the levees of various sloughs, channels, and other waterways within the historic floodplain. Native habitats include remnant riparian vegetation that persists in some areas, with brackish and freshwater marshes also being present.

San Luis Reservoir

The San Luis Reservoir, and the associated O'Neill Forebay, is a water storage reservoir complex located in the eastern part of the Diablo Range in west central California. Filling of San Luis Reservoir inundated historic grassland, mesic valley slope, and creek habitats (Reclamation and CDPR 2005). Areas at the edges of O'Neill Forebay reportedly appear to be slowly becoming vegetated with riparian species (Reclamation and CDPR 2005). Riparian vegetation along the shoreline of San Luis Reservoir likely would remain in an early successional stage under normal operating conditions because the fluctuation of the water surface elevation (reportedly 100 feet or more) either inundates the vegetation for extended periods or desiccates the vegetation for extended periods during the dry season.

3.6.2 Species Occurrence within the Action Area

Several information sources were used to identify special-status species occurring or potentially occurring within the Action Area, including aerial photographs, site topographic maps, and USFWS, California Natural Diversity Database (CNDDB), and California Native Plant Society (CNPS) special status species lists for the Bohemotash Mountain, Bunker Hill, Clarksville, Clifton Court Forebay, Folsom, Minnesota Mountain, O'Brien, Pacheco Pass, Pilot Hill, Rocklin, San Luis Dam, and Shasta Dam, California 7.5 minute USGS topographic quadrangles (quads). Species occurring in waterways between these quads and within the Action Area were also assessed. The above listed quads were focused on due to the removal of or retention of water at water bodies or facilities within these quads. The Federal and State listed, proposed listed, and candidate species under the Federal or State ESAs that occur, or have the potential to occur, within the Action Area are listed in **Table 3-5**. Appendix B contains detailed accounts of the special-status terrestrial and riparian species in the Action Area.

Table 3-5. Federal and State listed, Proposed Listed, and Candidate Terrestrial and Riparian Species Potentially Occurring within the Action Area

Species	Common Name	Status Federal[1]/ State[2]/ CNPS[3]	Habitat Requirements	Location (USGS Quadrangle)	Potential to Occur within Action Area
Invertebrates					
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT/--/--	Typically found in riparian elderberry shrubs	Bohemotash Mountain, Clarksville, Clifton Court Forebay, Folsom, Minnesota Mountain, O'Brian, Pilot Hill, Rocklin, San Luis Dam, Shasta Dam	May occur within the riparian habitats along reservoirs and rivers within the Action Area.
Pacifastacus fortis	Shasta crayfish	FE/--/--	Cool, clear, spring-fed lakes, rivers and streams, near spring inflow source. Require volcanic rock rubble in substrate.	Minnesota Mountain, O'Brian	Shasta Reservoir may provide potential habitat; occurrence is unlikely due to limited distribution.
Amphibians					
Rana aurora draytonii	California red-legged frog	FT/CSC/--	Permanent and semi-permanent quiet aquatic environments with emergent, submergent, and riparian vegetation. Coastal drainages in Central CA and scattered streams in the Sierra Nevada	Bohemotash Mountain, Clarksville, Clifton Court Forebay, Folsom, Minnesota Mountain, O'Brien, Pacheco Pass, Pilot Hill, Rocklin, San Luis Dam, Shasta Dam	May occur within reservoirs and smaller river habitats within Action Area.
Rana boylii	foothill yellow-legged frog	--/CSC/--	Shallow flowing streams with some cobble in woodlands, riparian forest, coastal scrub, chaparral, and wet meadows. Rarely encountered far from permanent water sources. Elevations; 0-1830 m.	Bohemotash Mountain, Minnesota Mountain, O'Brien, Shasta Dam	While this species is not likely to occur directly in the Action Area, it may occur adjacent to Action Area, within smaller creeks that drain into the Sacramento River.

Table 3-5. Federal and State listed, Proposed Listed, and Candidate Terrestrial and Riparian Species Potentially Occurring within the Action Area (cont.)

Species	Common Name	Status Federal[1]/ State[2]/ CNPS[3]	Habitat Requirements	Location (USGS Quadrangle)	Potential to Occur within Action Area
Rana muscosa	mountain yellow-legged frog	FC/CSC/--	Streams, lakes and ponds in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitat types at elevations above 5,940 ft in the Sierra Nevada	Bunker Hill	May occur within reservoirs and smaller associated streams within Action Area.
Mammals					
Antrozous pallidus	pallid bat	--/CSC/--	Grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. Roosts include cliffs, abandoned buildings, bird boxes, and under bridges.	Folsom	May occur on bridges and dam structures within Action Area.
Corynorhinus townsendii	Townsend's big-eared bat	--/CSC/--	Caves, mines, tunnels, buildings, or other human-made structures for roosting. Hibernation sites must be cool and cold, but above freezing.	Minnesota Mountain	May occur on bridges and dam structures within Action Area.
Reptiles					
Actinemys marmorata marmorata	Northwestern pond turtle	--/CSC/--	Ponds, marshes, rivers, streams, and irrigation ditches with aquatic vegetation. Requires basking sites and suitable upland habitat for egg laying.	Bohemotash Mountain, Clarksville, Clifton Court Forebay, Folsom, Minnesota Mountain, O'Brien, Pacheco Pass, Pilot Hill, Shasta Dam	May occur within reservoirs and smaller river habitats within Action Area.
Thamnophis gigas	Giant garter snake	FT/ST/--	Sloughs, irrigation ditches, and channels for foraging, grassy banks, and emergent vegetation for basking	Clarksville, Clifton Court Forebay, Folsom, Rocklin, San Luis Dam	May occur within smaller river and drainage habitats in the southern portion of Action Area.

Table 3-5. Federal and State listed, Proposed Listed, and Candidate Terrestrial and Riparian Species Potentially Occurring within the Action Area (cont.)

Birds					
Accipiter gentilis	northern goshawk	--/CSC/--	Forages in wooded areas, generally coniferous or deciduous forests with large snags and riparian habitat. Nests in mature, dense, coniferous forests near water.	Bunker Hill	May forage in riparian habitats along rivers within Action Area.
Agelaius tricolor	tricolored blackbird	--/CSC/--	Nests in dense thickets of cattails, tules, willow, blackberry, wild rose, and other tall herbs near fresh water.	Clarksville, Clifton Court Forebay, Folsom, Pilot Hill, San Luis Dam	May nest in riparian habitat associated with reservoirs and rivers within Action Area.
Buteo swainsoni	Swainson's hawk	--/ST/--	Nests primarily in riparian habitats, forages over open grasslands and agricultural fields	Clifton Court Forebay, San Luis Dam	May nest in riparian habitat along rivers within Action Area.
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	FC/CE/--	Frequents valley foothill and desert riparian habitats. Inhabits open woodlands with clearings, and riparian habitats with dense understory foliage along slow-moving drainages, backwaters, or seeps. Prefers dense willows for roosting, but will use adjacent orchards.	Bohemotash Mountain, Minnesota Mountain, O'Brian, Shasta Dam	May occur within riparian habitat associated with reservoirs and rivers within Action Area.
Circus cyaneus	northern harrier	--/CSC/--	Coastal scrub, Great Basin grassland, marsh and swamp (coastal and fresh water), riparian scrubs, valley and foothill grassland, and wetlands.	Clifton Court Forebay, Pacheco Pass, San Luis Dam	May nest in riparian habitat along rivers within Action Area.
Falco peregrinus anatum	American peregrine falcon	FD/SE/--	Breeds mostly in woodland, forest, and coastal habitats. Breeds near water on high cliffs or banks and will nest on human-made structures.	Bohemotash Mountain	May nest on bridges and dam structures within Action Area.
Haliaeetus leucocephalus	Bald eagle	FD/SE/--	Nests and roosts in coniferous forests near lakes, reservoirs, and rivers	Bohemotash Mountain, Clarksville, Folsom, O'Brien, Pilot Hill, Rocklin, Shasta Dam	Reservoirs within Action Area may provide foraging habitat.

Table 3-5. Federal and State listed, Proposed Listed, and Candidate Terrestrial and Riparian Species Potentially Occurring within the Action Area (cont.)

Laterallus jamaicensis coturniculus	California black rail	--/CT/--	Nests in high portions of salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation.	Rocklin	May occur within riparian habitat associated with reservoirs within Action Area
Progne subis	purple martin	--/CSC/--	Nests in tree cavities. Generally restricted to areas with dead trees containing woodpecker holes. Also in “weep holes” in freeway and street overpasses.	Minnesota Mountain, Rocklin	Bridges crossing over rivers within the Action Area may provide nesting habitat.
Plants					
Gratiola heterosepala	Boggs Lake hedge-hyssop	--/SE/1B	Marshes and swamps, lake margins, and vernal pools.	Rocklin	May occur within the lake margins within Action Area.
Lilaeopsis masonii	Mason’s lilaeopsis	--/Rare/1B	Brackish or freshwater marshes and swamps and riparian scrub.	Clifton Court Forebay	Habitat associated with reservoir margins within Action Area.
Neviusia cliftonii	Shasta snow-wreath	--/--/1B	Cismontane woodland, lower montane coniferous forest, riparian woodland, streamsides and sometimes in carbonate, volcanic, and metavolcanic soils.	Minnesota Mountain, O’Brian	May occur along the banks of reservoir or river habitats within Action Area.
Sagittaria sanfordii	Stanford’s arrowhead	--/--/1B	Marshes and swamps.	Clarksville	Habitat associated with reservoir margins within Action Area may provide habitat.

1 Federal Status: FE=Endangered; FT=Threatened; FP=Proposed Endangered or Threatened; FC=Candidate; DM=De-listed (monitored first 5 years)

2 State Status: SE=Endangered; ST=Threatened; CSC=Species of Special Concern3

CNPS: 1B=Rare, threatened, or endangered in California or elsewhere

Source: CDFG CNDDB, NMFS, and USFWS species list

3.6.3 Regulatory Setting

Federal

Federal Endangered Species Act The ESA requires that both USFWS and NMFS maintain lists of threatened species and endangered species. An “endangered species” is defined as “any species which is in danger of extinction throughout all or a significant portion of its range.” A “threatened species” is defined as “any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 USC 1532). Section 9 of the ESA makes it illegal to “take” (i.e., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such conduct) any endangered species of fish or wildlife and most threatened species of fish or wildlife (16 USC 1538).

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each Federal agency must consult with USFWS if the Federal agency determines that its action might impact a listed species.

Reclamation CVPIA Level 4 Wildlife Refuge Water Purchase Program Section 3406(d)(1) of the CVPIA, Title XXXIV of the Reclamation Projects Authorization and Adjustment Act of 1992 (PL 102-575), requires the Secretary of the Department of the Interior (Secretary) to provide firm delivery of Level 2 and 2/3 Full Habitat Development water supplies to the various refuges’ habitat areas identified in Reclamation's Refuge Water Supply Report. This report describes water needs and delivery requirements for each wetland habitat area to accomplish stated refuge management objectives. In the Refuge Water Supply Report, historical deliveries were termed Level 2, and the quantity of water needed to achieve full development was termed Level 4. Section 3406(d)(1) of the CVPIA requires the Secretary to provide firm delivery of Level 2 water supplies to each NWR in the Central Valley. Section 3406(d)(2) of the CVPIA further directs the Secretary to provide additional water supplies to meet Level 4 needs through the acquisition of water from willing sellers. The water to be acquired is known as Incremental Level 4 supplies. Incremental Level 4 supplies, when added to Level 2 supplies, make up full Level 4 supplies. In recent years, acquired water to meet Level 4 needs has averaged between 70,000 to 80,000 AF.

State

California Endangered Species Act Under the State ESA (Fish and Game Code Sections 2050 to 2097), California’s Fish and Game Commission is responsible for maintaining lists of threatened and endangered species. The State ESA prohibits the “take” of listed and candidate (petitioned to be listed) species. “Take” under California law means to “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, capture, or kill” (California Fish and Game Code, Section 86).

California Native Plant Protection Act The California Native Plant Protection Act (NPPA) contains requirements to preserve, protect, and enhance rare and endangered native plants, in addition to those in the State ESA. The definitions of rare and endangered in NPPA differ from those in State ESA, but the list of protected native plants encompasses the Federal and State ESAs candidate, threatened, and endangered species. The NPPA also includes restrictions on take, stating that, "no person shall import into this state, or take, possess, or sell within this state" any rare or endangered native plant, except as provided in the NPPA. The exception is where landowners have been notified of the presence of protected plants by CDFG. In this case, the landowner is required to notify CDFG at least 11 days in advance of changing land uses to allow CDFG an opportunity to salvage the plants.

3.7 Recreation

Wildlife viewing, fishing, waterfowl hunting, swimming, motor boating, rafting, sailing, and windsurfing are important water-enhanced or water-dependent recreational activities throughout California. The quality of recreation at lakes and reservoirs depends largely on surface water levels. Rafting and boating are popular activities that are often dependent on appropriate river flows and reservoir water levels for maximum enjoyment. Enjoyment of water-enhanced activities, such as picnicking and hiking, also can be related to water levels.

Potential changes in reservoir water surface elevations and river flows could affect water-enhanced and water-dependant recreational activities such as boating, swimming, and fishing. This section describes the existing recreational resources associated with surface water bodies and related facilities that provide water-related recreational opportunities within the Action Area.

3.7.1 Environmental Setting

Middle Fork and North Fork American Rivers

The Middle Fork American River below Ralston Afterbay lies within the Auburn State Recreation Area (SRA) and extends 24 miles downstream to the confluence with the North Fork American River. The Middle Fork American River is the most popular river in the Auburn SRA for whitewater boating. Water released from the MFP through Ralston Afterbay supports river rafting, kayaking, and canoeing throughout the year. PCWA has an informal arrangement with Middle Fork American River commercial whitewater companies to release water from Ralston Afterbay on weekend mornings to augment flows down the river for whitewater use. Releases of 1,000 to 1,100 cfs typically are released beginning at 7:00 am and continue to be released for several hours, depending upon water operations (Anderson 1998). Water released at 7:00 am usually reaches the confluence of the Middle and North Fork North American rivers at approximately 3:00 pm. The released water provides boating opportunities along the Middle Fork American River. The releases are particularly important during the summer and early fall months when river flows may be below 300 cfs. Adequate flows for whitewater boating are about 1,000 cfs, and the minimum flow needed is approximately 800 cfs (Anderson 1998; Cassady and Calhoun 1995).

Most whitewater boating occurs during the summer (97 percent of the year's whitewater use), with the boating season beginning in late May and extending into September (CDPR and Reclamation 1992). The majority of the river reaches in the Middle Fork American River tend to be difficult for boaters and require intermediate to advanced skill levels, or the services of a commercial rafting company (Anderson 1998). Riparian vegetation along these rivers provides sightseeing, bird watching, and photographic opportunities. Other river-related uses that occur in the area include fishing, swimming, hiking, and sunbathing.

The North Fork American River from a point 0.3 miles above Heath Springs downstream to a point 1,000 feet upstream of the Colfax-Iowa Hill Bridge has been designated under the National Wild and Scenic Rivers Act (Public Law 95-625, November 10, 1987 (38.3 miles). The Middle Fork American River is under study to be designated as a National Wild and Scenic River. Until all phases of the study are completed, the Middle Fork American River is afforded the same protections as a wild and scenic river, due to its outstanding resource values.

French Meadows and Hell Hole Reservoirs French Meadows Reservoir, which is on the Middle Fork American River, provides recreational opportunities for camping, boating, picnicking, horseback riding, and hiking. The reservoir provides boat access via two launch sites. The boat ramps become unavailable to trailers when the storage drops below 58,700 AF (5,206 feet msl) (PCWA 2001). Fishing for rainbow and brown trout is also a popular recreational activity.

Hell Hole Reservoir is in the El Dorado National Forest on the Rubicon River, a tributary to the Middle Fork American River. The primary recreational activities on this reservoir are camping and fishing. One boat launch site suitable for small craft is accessible when storage in the reservoir is above 106,150 AF (4,540 feet above msl) (PCWA 2001). Fifteen boat access sites (for small craft) also are available on the lake.

When the boat ramps become unavailable, boating is restricted to small craft that can be carried to and from the shore. The boat ramps are most commonly inoperable in the winter months, when use is minimal or the reservoirs are inaccessible due to snow.

Folsom Reservoir and Lake Natoma California Department of Parks and Recreation (CDPR) manages the Folsom Reservoir SRA, which includes Folsom Reservoir and Lake Natoma. There are 176 campsites that accommodate tent, trailer, RV and group campers; 11 day-use areas; and over 90 miles of existing trails in the Folsom Reservoir SRA (Reclamation 2005).

Visitation peaks during the summer and diminishes during the fall and winter. Seventy-five percent of all visits to the SRA occur during the spring and summer months. Water-enhanced (land-based) activities at the SRA account for approximately 15 percent of the total recreation demand, and water-dependent activities account for nearly 85 percent. Water-dependent activities on Folsom Reservoir include boating, personal watercraft use (jet skis), windsurfing, water skiing, rafting, swimming, and fishing. On Lake Natoma, water-dependent activities include paddling (kayaking, rowing, canoeing, and outriggers), swimming, and fishing. Boating accounts for approximately 30 percent of the total recreation demand at the Folsom Reservoir SRA, swimming and wading account for 27 percent, fishing accounts for nearly 20 percent, and 23 percent consists of picnicking, camping, and miscellaneous water-dependent activities (Reclamation 2005).

Recreation use and quality of the Folsom Reservoir SRA are closely related to Folsom Reservoir's function as a flood control, irrigation, and water supply reservoir, particularly as it relates to water surface elevations of the lake. Folsom Reservoir water surface elevations directly affect the availability of boat ramps, beaches, berth sites, and other facilities that depend on water depth or surface area. These elevations can vary as much as 70 feet in normal years. The highest surface elevations occur during the rainy season and spring run-off during late winter and early spring. The lowest surface elevations occur during late fall or early winter prior to the beginning of the rainy season. The surface water elevations drop continuously from the beginning of the recreation season (Memorial Day) through the end of the season (Labor Day). Surface elevations during normal years generally fall from an elevation of approximately 466 feet msl at the beginning of the season to a low of approximately 405 feet msl in late fall, after the season has ended (Reclamation 2005).

Major facilities at Folsom Reservoir include six developed boat-launching areas, one marina, and two formal beach areas. If Folsom Reservoir's surface water elevation stays above approximately 405 feet msl, berthing slips for year-round mooring are available. When reservoir elevations rise higher than about 450 feet msl, lake inundation results in nearshore boat ramps and parking spaces becoming unavailable, affecting the carrying capacity of the reservoir. When reservoir water levels decline below 436 feet msl, submerged boat ramps become exposed and can become unusable when the surface water elevation drops to approximately 420 feet msl. Summer is the most sensitive time to changes in water surface elevations because a lack of access to a recreational facility could occur (Reclamation 2005).

Lake Natoma is located at the downstream end of the Folsom Reservoir SRA. Nimbus Dam and Lake Natoma regulate releases to the lower American River while allowing varied water releases from Folsom Dam so that power production benefits can be optimized. The water surface elevation typically fluctuates four to seven feet daily. Recreation use on Lake Natoma is less affected than at Folsom Reservoir due to the minimal changes in water surface elevation (Reclamation 2005).

Major facilities at Lake Natoma include three boat launching areas, formal beaches at Negro Bar and Nimbus Flat, and the California State University, Sacramento Aquatic Center just upstream of Nimbus Dam. The Aquatic Center provides instruction and equipment rentals for rowing, sailboarding, canoeing, and small boat sailing. Other Lake Natoma facilities include several picnic areas and an 8-mile segment of the American River paved trail that is used by equestrians, hikers, runners, mountain bikers, and in-line skaters. Bank fishing is common, and swimming and diving occur from the rock outcrops at the upper end of the lake. The predominant recreational activity is trail use (jogging, bicycling, hiking, and horseback riding). Summer water temperatures in Lake Natoma are generally much cooler than in Folsom Reservoir. Therefore, Lake Natoma is less intensely used for swimming and wading (Reclamation 2005).

Lake Natoma supports an average of a half-million visitor-days per year, which is greatest during the spring and summer. Water-enhanced activities account for approximately 50 percent of all recreation activities, and water-dependent activities account for the remaining 50 percent. Trail use accounts for 33 percent of the total recreation demand, rafting and boating account for 30 percent, swimming and wading account for 12 percent, picnicking and related activities account for 10 percent, fishing accounts for 8 percent, and nature study/sightseeing accounts for 7 percent of the total recreation demand (Reclamation 2005).

Lower American River

Recreational opportunities along the lower American River primarily are associated with the American River Parkway (Parkway). The 23-mile Parkway parallels the lower American River from Nimbus Dam to the confluence with the Sacramento River. The Parkway includes 14 parks along the publicly owned lands of the river. Sacramento County operates and maintains facilities within the Parkway downstream of Nimbus Dam; CDPR operates and maintains facilities upstream of the dam.

The American River is popular with fishing enthusiasts, canoeists, kayakers, and rafters, and the Parkway offers several picnic areas and opportunities for nearby golf, guided natural and historic tours, archery, and game fields.

More than five million visitors use the Parkway yearly. Approximately 31 percent of all visits were associated with water-dependent activities (swimming, boating, and fishing), and 69 percent were associated with water-enhanced activities (jogging, nature study, hiking, and picnicking) (Reclamation 2005).

The lower American River has been designated as a Wild and Scenic River pursuant to both the State and Federal Wild and Scenic River Acts. This designation prohibits Federal construction, assistance, and licensing of water resource projects that would adversely affect the values for which the designated river segments are included in the national system. The lower American River is a major site for recreational boating (rafting, kayaking, and canoeing). The level of lower American River boating activity, particularly commercial rafting, primarily depends on air temperature, river flows, and season. The boating and rafting season generally is between April and October. Fishing is permitted in the Parkway year-round except during fall and early winter, when portions of the river are closed to protect spawning fish. Swimming and wading are other popular water-dependent activities affected by river flows.

Sacramento River

The Sacramento River and major upstream reservoirs support a broad range of water-dependent and water-enhanced recreation opportunities, including reservoir and river facilities for boating, fishing, swimming, hunting, and camping. While fishing is a year-round activity, boating, rafting, and swimming use take place primarily in summer months when air temperatures are high.

Fishing, rafting, canoeing, kayaking, swimming, and boating are popular activities along most reaches of the Sacramento River. Whitewater rafting and other boating-type recreational activities are generally seasonal and are dependent on river flows. Additional recreational activities along the Sacramento River include hiking, wildlife viewing, and camping.

Wildlife refuges along the Sacramento River provide fishing, hunting, and wildlife viewing opportunities. These refuges include the Sacramento, Colusa, Sutter, and Delevan NWRs and Gray Lodge WMA. Water supplies for certain wildlife refuges within the Central Valley are administered through CVPIA programs that acquire and convey water. Water for refuges is acquired through water supply contracts with “willing sellers.”

As a recreational resource, the lower Sacramento River reach between the American River confluence and the Delta is closely associated with recreational use of Delta waterways due to the influence of tidal action. This section of the river is an important boating and fishing area with several private marinas located on the river. This lower reach of the river is a popular boating and fishing area with dispersed public access, several private marinas, and extensive boat traffic, particularly in the summer.

Sacramento-San Joaquin Delta

Hunting, fishing, wildlife viewing, and water-based recreation such as boating, swimming, sailing, windsurfing and other activities are popular recreational activities throughout the Delta. The facilities available to boaters and other recreational users include marinas, city or county public access areas, hunting clubs, and yacht or waterskiing clubs. The increasing demand for Delta recreation opportunities spurred the state to establish Brannan Island SRA in 1965 and Franks Tract SRA in 1966. Popular areas also include the Sherman Island Wildlife Area, Twitchell Island, Franks Tract SRA, and the Clifton Court Forebay.

Historically, year-round sport fishing from shore locations, piers, and boats has been a major activity in the Delta. According to the Delta Protection Commission (DPC), sportfishing tournaments are important recreational activities that contribute to the local economy. Important Delta sport fisheries include striped bass, shad, black bass, catfish, Chinook salmon, and steelhead.

Most of the navigable waterways in the Delta are public, and most of the land is private. The lack of public lands limits the use of the Delta for recreation. Public use of the Delta is concentrated in a few areas where marinas and other facilities provide recreational opportunities and access to the Delta waterways, and at roadside areas where public roads are adjacent to the waterways. There are few public parks. Some of the recreation areas in the Delta are accessible only by boat, thus limiting shoreline fishing opportunities in the Delta.

Popular access points for boating, waterskiing, and personal watercraft use include Windmill Cove near State Route 4; King Island; Paradise Point; Herman & Helen’s Marina on Eight Mile Road; Tower Park near State Route 12; and Del’s Boat Harbor near the City of Tracy. Houseboating also is concentrated along Eight Mile Road. Windsurfing, a popular sport in the Delta, typically occurs along SR 160 between Sherman Island and Rio Vista and at Windy Cove. Windy Cove is a new facility constructed at Brannan Island SRA and is the only formal windsurfing site in the area. Waterfowl and pheasant are hunted at Wildlife Management Areas including Grizzly Island, Joice Island, and Sherman Island, in addition to a variety of State cooperative hunting areas.

San Luis Reservoir

San Luis Reservoir and O’Neill Forebay provide for activities such as boating, waterskiing, fishing, camping, and picnicking. San Luis Reservoir is open year-round. Boat access is available in the Basalt area located in the southeastern portion of the reservoir and at Dinosaur Point in the northwestern portion of the reservoir. The usability of the Basalt boat ramp declines below reservoir elevations of 340 feet msl; and the Dinosaur Point boat ramp becomes difficult to access when the reservoir elevation is below 360 feet msl (USDOI et al.

1999). There are no designated swimming areas or beaches at San Luis Reservoir, but the O'Neill Forebay provides opportunities for swimming, boating, fishing and camping.

3.7.2 Regulatory Setting

Federal

National Wild and Scenic Rivers Act The National Wild and Scenic Rivers System was established in 1968 with the enactment of PL 90-542 (16 USC 1271 et seq.). Under this system, rivers possessing "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values" may be designated as wild, scenic, or recreational.

Clean Water Act The CWA is aimed at restoring and maintaining the chemical, physical and biological integrity of the nation's waters. The act requires that due regard be given to improvements necessary to conserve waters for public water supplies, propagation of fish and aquatic life, agricultural and industrial uses and recreational purposes, including recreation in and on the water. Within the Action Area, recreational contact and non-contact beneficial uses are designated.

State

State Wild and Scenic Rivers Act The State Wild and Scenic Rivers Act was passed by the California Legislature in 1972 (PRC Section 5093.50 et seq.). The Legislature declared that it was the state's intent that "certain rivers which possess extraordinary scenic, recreation, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state."

1992 Delta Protection Act The State's 1992 Delta Protection Act designates the Delta Primary Zone[5] as an area to be protected from intrusion of nonagricultural uses (Section 29703a), and establishes the DPC. In 1995, the DPC adopted its Regional Plan, Land Use and Resource Management Plan for the Primary Zone of the Delta. With respect to recreation, the Delta Protection Act includes the following provisions:

- The state's basic goals for the Delta include the protection, maintenance and, where possible, the enhancement and restoration of the overall quality of the Delta environment including, but not limited to, agriculture, wildlife habitat and recreational activities (Section 29702).
- Wildlife and wildlife habitats in the Delta are valuable, unique and irreplaceable resources of critical statewide significance, and it is the policy of the state that they should be preserved and protected for the enjoyment of current and future generations (Section 29705).

[5] "Primary Zone" is defined as "…the delta land and water area of primary state concern and statewide significance which is situated within the boundaries of the delta, as described in Section 12220 of the Water Code, but that is not within either the urban limit line or sphere of influence line of any local government's general plan or currently existing studies, as of January 1, 1992. The precise boundary lines of the primary zone includes the land and water areas as shown on the map titled "Delta Protection Zones" on file with the State Lands Commission. Where the boundary between the primary zone and secondary zone is a river, stream, channel, or waterway, the boundary line shall be the middle of that river, stream, channel, or waterway."(1992 Delta Protection Act Section 29728).

- Agricultural, recreational, and other uses of the Delta can best be protected by implementing projects that protect wildlife habitat before conflicts arise (Section 29710).
- The waterways and marinas in the Delta offer recreational opportunities of statewide and local significance, and are a source of economic benefit to the region, and because of increased demand and use, public safety requirements will increase (Section 29702).

3.8 Cultural Resources

Cultural resources is used to describe both ‘archaeological sites’ depicting evidence of past human use of the landscape and the ‘built environment,’ which is represented in structures such as dams, roadways, and buildings.

3.8.1 Environmental Setting

Middle Fork and North Fork American Rivers

The southern Maidu or Nisenan bands inhabited the upper and lower reaches of the American River watershed and practiced relatively the same cultural traditions and basketry production as their northern tribal family. Prehistoric sites on the upper reaches of the American River include midden deposits (loose, dark soil with organic debris containing burned food, charcoal, bone, and rock), lithic scatters, petroglyphs, settlements with house pits, rock shelters, and bedrock mortars. These sites were large and small villages, cemeteries, resource procurement and processing areas, quarries, ceremonial sites, workshops, and temporary campsites. Prehistoric archeological sites exist throughout the region, except on extremely rugged terrain and in areas without water. Most prehistoric sites of cultural interest in the area are found on gentle to moderately sloping sites within 500 feet of surface water sources (Placer County 1994).

French Meadows and Hell Hole Reservoirs The area within Hell Hole Reservoir has not been surveyed extensively; four surveys covered some of the area within 0.5 mile of the reservoir. One prehistoric site was recorded to be within 0.5 mile of the reservoir. Three studies constitute the body of literature that applies directly to Hell Hole Reservoir (Goddard 1985; Lasick 1997; Peterson 1993).

Surveys for cultural and historic resources exist for approximately 99 percent of French Meadows Reservoir and identify only a few sites within 0.5 mile of the project area. 1953 topographic maps reveal that there may be some unrecorded historic resources that are now under water. One archeological study identified a small “campsite” at the upper end of the reservoir (Shapiro and Jackson 1994). Six studies comprise the breadth of information gathered on cultural resources around French Meadows Reservoir (Baldrica 1989; Brooke 1999; DeMasi 1981; Miller 1990; Smith 1978; Smith 1994).

Lower American River

Fifty-two archaeological sites have been recorded in the lower American River. Of these 52 sites, seven sites are historic, 44 are prehistoric, and one site has prehistoric and historic components. Seven of the prehistoric sites have been destroyed or severely damaged. Prehistoric site types and features include village mounds and midden deposits, burials, artifact scatters, milling stations, and chipped and ground stone scatters. Historic site types and features include a cemetery, bridge abutments, a hydroelectric power system, mining tailings, and water pipes (Corps 1996a).

Folsom Reservoir and Lake Natoma A total of 157 archaeological sites have been recorded within or immediately adjacent to Folsom Reservoir. Of these, 34 sites are historic, 110 are prehistoric, and 13 have both historic and prehistoric components. Prehistoric site types and features include midden deposits, possible burials, chipped stone scatters, ground stone, milling stations, and artifact scatters. Historic site types and features include towns, foundations and structures, debris scatters and dumps, mining tunnels, rock walls, bridges, ditches, flumes and water pipes, and cemeteries and individual burial sites (Corps 1996b).

In addition to the recorded archaeological sites, four isolated artifacts have been recorded within Folsom Reservoir, one known prehistoric archaeological site was inundated before it could be recorded, and numerous historic sites and features have not been recorded (Peak & Associates 1990).

Prior to construction of Folsom Dam in 1955, only one archaeological survey of the reservoir basin had been completed (Fenenga 1948). One prehistoric site was documented within the planned reservoir pool. The results of this survey likely are a reflection of methodology considered appropriate during the time period in which the surveys were conducted, than of the actual prehistoric and historic settlement patterns now known to have occurred in the region. Since that survey, periodic investigations in the Folsom State Recreational Area have resulted in the generation of site records and survey reports describing nearly 170 archaeological sites within the area. The level of detail and accuracy of these reports varies widely (SAFCA and Reclamation 1994).

The Folsom Powerhouse was listed as a National Historic Landmark in 1973. In addition, a ditch runs within the drawdown zone of Folsom Lake that has been determined eligible for inclusion in the National Register. No other archaeological sites within Folsom Reservoir have been declared eligible or are listed in the National Register of Historic Places (NRHP) (SAFCA and Reclamation 1994).

Many studies have been carried out in and adjacent to the Folsom Reservoir basin. One hundred and twenty-three (123) prehistoric sites or components have been recorded, some with remnant patches of midden. Human burials are noted on a few of the early (1940s-50s) site records, but the present status of these burial sites is unknown. Forty-seven historic-period sites have been recorded at Folsom Reservoir, mostly related to mining, transportation, and settlement. Many of the recorded sites show signs of adverse effects from wave action, inundation, and/or recreation use at the reservoir (Corps 1996a).

Lake Natoma lies within the boundaries of the Folsom historic gold mining district. At least three known prehistoric sites were inundated by Lake Natoma (Corps 1996a).

Sacramento River

Many prehistoric and/or ethnographic sites were recorded along the banks of the lower Sacramento River in 1934 by R.F. Heizer, who described them as burial mounds which had been partially or completely leveled for agriculture or other development (Heizer 1934). Many of these were built on or adjacent to the natural levees, and over time have been severely affected by river erosion and levee construction (Bouey 1990). Excavations at a few of these mounds have shown them to contain human burials, grave offerings, and occupational debris, some of which are at least 2,000 years old (Bouey 1995; Milliken 1994; Olsen 1963). These sites, wherever they may survive, are extremely important. To date, the most complete field inventory of the lower Sacramento River has been done by Far Western (Bouey 1990) who surveyed and augered the toe of the levees between the Natomas Cross Canal and the town of Freeport. Two segments of the levee at the confluence have been recorded as historical features and one has been determined eligible for inclusion in the NRHP (Nilsson et al, 1995).

One historic feature adjacent to the river, the Walnut Grove Branch Line Railroad, is considered significant and eligible for inclusion on the NRHP. There also is the potential for other important historic resources along the river, where many landings, ferries, small settlements, and private homes/ranches are known to have been established between the 1850s and the 1930s (Bouey 1990). However, Bouey's survey did not detect the remains of any of these resources. The banks of the lower Sacramento River are considered highly sensitive for archaeological and historical resources.

Shasta Reservoir Archaeological records indicate that Native Americans used the forests and waters in the Shasta area for at least 7,000 years before European occupation. The Pit River and Wintu Indians were the predominant groups inhabiting the area around Shasta Reservoir. Numerous prehistoric sites are known within the drawdown zone of Shasta Reservoir. Small camps in particular are known to exist within this zone, and with fluctuating water levels and the lack of vegetation, they are periodically exposed to wave and wind action that deteriorates the sites. Looting of exposed sites is also a problem in this area (Corps 1995).

In 1991, Reclamation consulted with the SHPO regarding historical archaeological sites potentially affected by the Shasta Temperature Outflow Control Project (Reclamation 1991). It was determined that the Dam itself, constructed in 1938, is eligible for inclusion in the NRHP because of its historical and engineering significance.

Sacramento-San Joaquin Delta

The Delta is one of the most intensely investigated areas of California because of its high prehistoric population density and proximity to population centers. Although the bulk of cultural sites were recorded prior to 1960, there has been little systematic inventory for cultural resources. Most of the early archeological work in the region focuses on prominent prehistoric mounds. Documentation of historic sites has largely occurred within the last 20 to 30 years. At least 171 sites within the Delta Region have been listed in the NRHP as individual properties or districts. Six sites in the region also have been listed as California Historical Landmarks and four are listed as California Points of Historical Interest (CALFED 1998). Prehistoric site types include village sites, temporary campsites, milling-related activity sites, and lithic scatters. Potential historic resources in the Delta Region are largely related to agriculture; however, other types are present including farmsteads, labor camps, landings for the shipment of agricultural produce, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Forty-known historic sites coincide with prehistoric sites (CALFED 1998).

Several Native American burial and cremation sites have been discovered in the Delta Region. Native Americans in the Delta at the time of European contact were Northern Valley Yokuts who were settled along the San Joaquin River. Plains Miwok people lived primarily in the north with territory extending nearly to Sacramento (DWR and Reclamation 1996b). Wintun and Nisenan occupied areas on the north and northeastern Delta. Those in the south Delta proper were the Chulamni or Nochochomne.

San Luis Reservoir

In the 1960s, several State agencies conducted salvage excavation at San Luis Reservoir. Twenty-six cultural resources are located within San Luis Reservoir. Of these, 22 sites are located at an elevation of at least 400 feet above msl, and four sites occur between elevations of 250 and 275 feet above msl.

3.8.2 Regulatory Setting

Federal

Section 106 of the National Historic Preservation Act The National Historic Preservation Act (NHPA) of 1966 is the primary Federal legislation which outlines the Federal Government's responsibility to cultural resources. Section 106 of the NHPA requires the Federal Government to take into consideration the effects of an undertaking on cultural resources listed on or eligible for inclusion to the NRHP. Those resources that are on or eligible for inclusion to the National Register are referred to as historic properties.

The Section 106 process is outlined in the Federal regulations at 36 CFR Part 800. These regulations describe the process that the Federal agency (i.e., Reclamation) takes to identify cultural resources and the level of effect that the proposed undertaking will have on historic properties. In summary, Reclamation must first determine if the action is the type of action that has the potential to affect historic properties. If the action is the type of action that has the potential to affect historic properties, Reclamation must identify the area of potential effects (APE), determine if historic properties are present within that APE, determine the effect that the undertaking will have on historic properties, and consult with the State Historic Preservation Office (SHPO), to seek concurrence on Reclamation's findings. In addition, Reclamation is required through the Section 106 process to consult with Indian Tribes concerning the identification of sites of religious or cultural significance, and consult with individuals or groups who are entitled to be consulting parties or have requested to be consulting parties.

3.9 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the U.S. for federally-recognized Indian tribes or individual Indians. An Indian trust has three components: (1) the trustee, (2) the beneficiary, and (3) the trust asset. ITAs can include land, minerals, federally-reserved hunting and fishing rights, federally-reserved water rights, and in-stream flows associated with trust land. Beneficiaries of the Indian trust relationship are federally-recognized Indian tribes with trust land; the U.S. is the trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the U.S. The characterization and application of the U.S. trust relationship have been defined by case law that interprets Congressional acts, executive orders, and historic treaty provisions.

Consistent with President William J. Clinton's 1994 memorandum, "Government-to-Government Relations with Native American Tribal Governments," Reclamation assesses the effect of its programs on tribal trust resources and federally-recognized tribal governments. Reclamation is tasked to actively engage federally-recognized tribal governments and consult with such tribes on government-to-government level (59 Federal Register 1994) when its actions affect ITAs. The U.S. Department of the Interior (DOI) Manual Part 512.2 ascribes the responsibility for ensuring protection of ITAs to the heads of bureaus and offices (DOI 1995). DOI is required to "protect and preserve Indian trust assets from loss, damage, unlawful alienation, waste, and depletion" (DOI 2000). Reclamation is responsible for assessing whether the proposed action has the potential to affect ITAs.

Types of actions that could affect ITAs include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts on fish and wildlife where there is hunting or fishing rights, or noise near a land asset where it adversely affects uses of the reserved land.

On October 15, 2008 Reclamation determined that the action alternatives would not affect ITAs. The nearest ITA to the Action Area is the Santa Rosa Rancheria, which is approximately six miles east of the Action Area.

3.10 Environmental Justice

3.10.1 Environmental Setting

The Action Area is located in the Sacramento and San Joaquin valleys, which have a relatively high proportion of Hispanics; the per capita and median household incomes are all lower than the averages for the State. A portion of the housing is substandard and there is a reasonably high unemployment rate. Most of these people are migrant farm workers.

3.10.2 Regulatory Setting

Federal

Executive Order 12898 (Environmental Justice) Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission, by identifying and addressing disproportionately high adverse human health or environmental effects, including social and economic effects, of its programs and activities on minority populations and low-income populations of the United States.

Environmental justice refers to the fair treatment of people of all races, income, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no person or group of people should shoulder a disproportionate share of negative environmental impacts resulting from the execution of environmental programs.

3.11 Socioeconomics

Agriculture in the Central Valley is an important employer and affects the regional economy through the expenses of farmers as well as production of many crops that require processing or transportation after harvest. The Central Valley accounts for almost all of the U.S. production of many fruit and nut crops. Values of crop production per acre can range from $200 to $15,000 or more.

3.12 Land Use

Land use from the MFP reservoirs along the American River to the Sacramento River is predominantly riparian in nature, except for urban areas such as the cities of Folsom and Sacramento.

Land use in the Action Area downstream along the Sacramento River and downstream is primarily of an agricultural nature (e.g., livestock grazing, irrigated crop production, and orchard and vineyard operations). Almost 80 percent of the irrigated land in California is located in the Central Valley. Water deliveries for agriculture average about 22.5 million acre-feet per year, with the CVP providing about 25 percent, the SWP about 10 percent, local surface water rights about 30 percent, and groundwater about 35 percent. Farmers in irrigation districts that receive CVP supplies also use other supplies such as groundwater. Use of non-CVP sources varies annually because of changes in weather and crop market conditions (Reclamation Website 2008).

WWD and WWDD1 provide a timely, reliable and affordable water supply to their landowners and water users, and drainage service to those lands that need it. Formed in 1952, WWD encompasses more than 600,000 acres of farmland in western Fresno and Kings counties. The WWD serves approximately 600 family-owned farms that average 900 acres in size. WWD farmers produce more than 60 high quality commercial food and fiber crops sold for the fresh, dry, canned and frozen food markets, both domestic and export. More than 50,000 people live and work in the communities dependent on the WWD's agricultural economy. The communities in and near the WWD's boundaries include Mendota, Huron, Tranquillity, Firebaugh, Three Rocks, Cantua Creek, Helm, San Joaquin, Kerman, Lemoore and Coalinga.

4.0 Environmental Consequences

This chapter discusses the environmental consequences related to the execution of two concurrent one-year WA contracts to transfer 20,000 AF of water from PCWA to WWD and WWDD1. The Proposed Action and Summer 2009 Action Alternatives do not require construction activities, nor would they result in construction activities or land conversions. **Table 4-1** summarizes the effects of the No Action, Proposed Action, and Summer 2009 Action Alternatives.

Table 4-1. Summary of Effects of the No Action, Proposed Action, and Summer 2009 Action Alternatives for the Execution ofTwo WA Contracts to Deliver Water from PCWA to WWD and WWDD1

Resource	No Action Alternative	Proposed Action Alternative	Summer 2009 Action Alternative
Water Supply and Hydrology	No Effect	No Effect	No Effect
Surface Water Quality	No Effect	No Effect	No Effect
Hydropower	No Effect	No Effect	No Effect
Fisheries and Aquatic Resources	No Effect	No Effect	Possible Effect
Terrestrial and Riparian Resources	No Effect	No Effect	No Effect
Recreation	No Effect	No Effect	No Effect
Cultural Resources	No Effect	No Effect	No Effect
Indian Trust Assets	No Effect	No Effect	No Effect
Environmental Justice	Undesirable Effect	Beneficial Effect	Beneficial Effect
Land Use	Undesirable Effect	Beneficial Effect	Beneficial Effect
Socioeconomics	Undesirable Effect	Beneficial Effect	Beneficial Effect

4.1 Approach for Impacts Analysis

The analyses undertaken in this environmental document rely upon baseline information developed from several sources, including NMFS, USFWS, and CDFG. The hydrologic analysis is based upon data and output from: (1) CDEC recorded data; and (2) Reclamation’s monthly forecast of operations. This information was used to evaluate and describe hydrologic conditions within the Action Area’s waterbodies under the Proposed Action, Summer 2009 Action, and No Action Alternatives.

There are several re-regulating reservoirs, forebays, and afterbays, which would serve as flow-through facilities for larger storage reservoirs upstream of the Delta. These re-regulating reservoirs and their associated larger storage facilities (noted in parentheses) include Keswick Reservoir (Shasta Reservoir), Ralston Afterbay and Interbay Dam and Oxbow Reservoir (French Meadows and Hell Hole reservoirs), and Lake Natoma (Folsom Reservoir). No storage- or elevation-related changes in these re-regulating reservoirs, forebays, or afterbays are expected to occur from implementation of the action alternatives because, as regulating waterbodies of a larger storage reservoir, monthly storage and elevation fluctuate frequently, on a daily and hourly basis. Water transferred under the action alternatives would not contribute to changes in the frequency or duration of fluctuations in the storage or elevation of the re-regulating reservoirs, relative to the No Action Alternative. Consequently, no further description or assessment of potential storage-related effects in these waterbodies is warranted.

In addition, storage at French Meadows Reservoir would remain essentially equivalent to the No Action Alternative under the action alternatives, based upon information provided by PCWA. The storage in French Meadows Reservoir under the No Action Alternative and the action alternatives is estimated to range from 59,600 AF (at the beginning of November 2008) to 60,000 AF (end of December 2008). Because storage in French Meadows Reservoir is identical under the No Action and action alternatives, no further description or assessment of potential storage-related effects in French Meadows Reservoir is warranted.

Under the action alternatives, Reclamation would not enter into two one-year WA contracts with WWD and WWDD1. Therefore, WWD and WWDD1 would not each receive 10,000 AF of PCWA transfer water, respectively. There would be no change to instream flow releases in the Middle Fork and North Fork American River, lower American River, Sacramento River, and the Delta as a result of the No Action Alternative. The following analysis identifies potential environmental effects of the action alternatives when compared to the No Action Alternative.

4.2 Flow Schedules

4.2.1 Proposed Action

Under the Proposed Action Alternative, the transfer of 20,000 AF to WWD and WWDD1 is expected to take place in November and December 2008 (see project description). Following are detailed descriptions of operations associated with the Proposed Action Alternative relative to the No Action Alternative, which provide the basis to evaluate changes between the two alternatives.

Middle Fork and North Fork American Rivers

Although the Proposed Action Alternative would transfer water from Hell Hole Reservoir on the Rubicon River, the upstream reach of the Rubicon River between Hell Hole Reservoir and Ralston Afterbay flow rate would not change because the water transfer would occur via an enclosed delivery conduit. Therefore, the upstream river reaches of both the Middle Fork American River and Rubicon River would not be subject to changes in flow, relative to the No Action Alternative, as a result of the proposed water transfer.

Below Oxbow Powerhouse on the Middle Fork American River, the transfer water would be used to provide additional on-peak generation under the Proposed Action Alternative. The Oxbow Powerhouse would be used at capacity for more time during the day compared to the No Action Alternative. The minimum and maximum flow rates for the day would remain the same as under the No Action Alternative (ranging from approximately 240 to 1,000 cfs per day); only the duration of the maximum flow would increase for up to ten hours per day during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow.

Lower American River below Nimbus Dam

The total river release under the Proposed Action Alternative during November through December would be approximately 100 cfs higher from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the lower American River below Nimbus Dam (**Table 4-2**).

Table 4-2. Average Releases from Nimbus and Keswick Dams under the No Action and Proposed Action Alternatives during November and December 2008.

Month	Dates	Nimbus (cfs)		Keswick (cfs)*	
		No Action	Proposed Action	No Action	Proposed Action
November	1-9	1,000	1,000	4,875	4,875
November	10-30	1,000	1,100	4,875	4,775
December	1-15	1,000	1,100	4,079	3,979
December	16-31	1,000	1,000	4,079	4,079

* Keswick releases are only approximate given the numerous controlling factors on the Sacramento River system and may vary during these periods. On average, the Keswick release will be lower by 100 cfs through the Proposed Action Alternative.

Sacramento River

The total river release under the Proposed Action Alternative during November through December would be approximately 100 cfs lower from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the Sacramento River below Keswick Dam (Table 4-2). Although Keswick releases in the No Action Alternative are considered minimal under current conditions, the additional flows in the American River, provided by the Proposed Action Alternative, allows the CVP an increment of operational buffer to make a small additional reduction in Keswick release.

Flows on the lower Sacramento River (below the confluence with the lower American River) would not change from November 10 through December 15, 2008 under the Proposed Action Alternative, relative to the No Action Alternative.

Sacramento-San Joaquin Delta Inflows and Export Pumping

Inflows into the Delta would not change under the Proposed Action Alternative relative to the No Action Alternative, because flows below the confluence of the lower American River and Sacramento River would not change from November 10 to December 15, 2008. In addition to no change in Delta inflows under the Proposed Action Alternative relative to the No Action Alternative, export pumping from the Jones Pumping Plant would not change.

Consideration also is given to the manner in which additional storage realized with the implementation of the Proposed Action Alternative relative to the No Action Alternative would be released subsequent to December 15, 2008. For the purpose of analysis of the Proposed Action Alternative, operational assumptions include the consideration that the additional 7,141 AF of storage in Shasta Reservoir, and 12,859 AF in Folsom Reservoir on December 15, 2008 become integrated into CVP operations. More specifically, these storage amounts become a component of 2009 CVP integrated operations and would be released from the reservoirs consistent with instream requirements, Delta standards, and water deliveries over the course of the year. Full CVP allocations during years when water availability permits are approximately 6,900,000 AF. An increment of 20,000 AF comprises approximately 0.3 percent of full CVP allocations. CVP allocations during a critical year represent the basis from which the transfer amount would represent the highest percentage of overall CVP allocations. CVP allocations in 1994 were the lowest in recent history, because that year was the last critically dry year in a series of critically dry years, with CVP allocations of about 2,400,000 AF. An increment of 20,000 AF comprises approximately 0.8

percent of CVP allocations under that situation. Hence, changes in flows in the lower American and Sacramento rivers, Delta inflow, or export pumping, over the course of the year would be de minimus (or non-observable) due to the very small incremental alterations in CVP operations associated with the Proposed Action Alternative.

4.2.2 Summer 2009 Action Alternative

Under this Alternative, 20,000 AF of water would be released from PCWA MFP reservoirs during November and December 2008, and stored in Folsom Reservoir for later transfer to WWD and WWDD1 during July and August 2009. Following are detailed descriptions of operations associated with the No Action Alternative and Summer 2009 Action Alternatives, which provide the basis to evaluate changes between these two alternatives.

Middle Fork American River below Oxbow Powerhouse and North Fork American River

Identical to the Proposed Action Alternative, under the Summer 2009 Action Alternative, the proposed use of the transfer water is to provide additional on-peak generation. Hence, the Oxbow Powerhouse would be used at capacity for more time during the day compared to the No Action Alternative. The minimum and maximum flow rates for the day would remain the same in the Middle Fork American River below Oxbow Powerhouse as under the No Action Alternative (ranging from approximately 240 to 1,000 cfs per day); only the duration of the maximum flow would increase for up to ten hours per day during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow.

Lower American River below Nimbus Dam

Under the Summer 2009 Action Alternative, the transfer water would be released from Folsom Reservoir during July and August of 2009. Flows in the lower American River below Nimbus Dam would remain the same as the No Action Alternative except for these two months (**Table 4-3**). Consequently, flows would be approximately 163 cfs higher on average during July and August of 2009 than flows expected under the No Action Alternative in the lower American River below Nimbus Dam (Table 4-3). Actual increases in daily flows may vary from these estimates to best manage cold water resources to optimally meet seasonal temperature and flow targets on the lower American River.

Sacramento River

Flows in the Sacramento River below Shasta and Keswick dams would not change during any month included in the assessment. In the lower Sacramento River below the confluence with the lower American River, flows would not change during any month included in the assessment with the exception of July and August 2009. During July and August 2009, flows in the lower Sacramento River would increase 163 cfs under the Summer 2009 Action Alternative, relative to the No Action Alternative.

Table 4-3. Average Releases from Nimbus and Keswick Dams under the No Action and Summer 2009 Action Alternatives from November 2008 through August 2009

Month	Nimbus (cfs)		Keswick (cfs)	
	No Action	Summer 2009 Action	No Action	Summer 2009 Action
November	1,000	1,000	4,875	4,875
December	1,000	1,000	4,079	4,079
January	1,000	1,000	3,250	3,250
February	1,441	1,441	4,050	4,050
March	1,542	1,542	5,000	5,000
April	2,148	2,148	7,000	7,000
May	1,000	1,000	8,500	8,500
June	2,651	2,651	11,500	11,500
July	3,690	3,753	12,000	12,000
August	2,772	2,935	9,500	9,500

* Keswick releases are only approximate given the numerous controlling factors on the Sacramento River system and may vary during these periods. On average, the Keswick release will be lower by 100 cfs through the Proposed Action Alternative.

Sacramento-San Joaquin Delta Inflows and Export Pumping

Inflows into the Delta would not change under the Summer 2009 Action relative to the No Action Alternative during any month included in the assessment, with the exception of July and August 2009. During July and August 2009, inflows into the Delta would increase 163 cfs on average and would follow with the increased releases on the American River.

Export pumping from the Jones and Banks pumping plants would not change during any month included in the assessment, with the exception of July and August 2009. During July and August 2009, export pumping from the Jones and Banks pumping plants would increase to amounts equal to 163 cfs minus carriage water costs. Carriage water losses are typically about 20 percent. Therefore, the actual volume of export pumping is expected to be between 16,000 and 18,000 AF, resulting in an estimated increase in Delta export pumping of 130 to 146 cfs during July and August 2009. Export pumping capacity availability at Jones or Banks pumping plants during July and August of 2009 would be ultimately determined at that time. However, Reclamation’s operational forecast indicates that Reclamation’s pumping would be maximized at the Jones Pumping Plant, with additional 11,000 AF of CVP water pumped at the Banks Pumping Plant during both July and August of 2009. Therefore, combined CVP and SWP pumping at Banks and Jones pumping plants under the No Action Alternative is presently anticipated to be at a rate of 6,538 cfs during July, and 5,871 cfs during August 2009. Under the Summer 2009 Action Alternative, anticipated combined CVP and SWP pumping at both facilities is expected to be at rates ranging from 6,668 to 6,684 cfs during July, and 6,001 to 6,017 cfs during August 2009.

4.3 Water Supply and Hydrology

The analysis of the potential effects on water resources associated with the alternatives was based on the following criteria:

- Reductions in reservoir storage or river flows, relative to the No Action Alternative, of sufficient magnitude, to affect the water supply availability to CVP and PCWA contractors.

4.3.1 Proposed Action

Middle Fork American River below Oxbow Powerhouse and North Fork American River

As of previously described in Section 2.1, water in storage at Hell Hole Reservoir would be sufficient to meet all of PCWA contractual obligations, including PCWA's own use, with the implementation of the Proposed Action Alternative. The transfer water would be used to irrigate lands in WWD and WWDD1. To transfer this water, additional on-peak generation would be needed. The minimum and maximum flow rates for the day would remain the same as under the No Action Alternative, although the duration of the maximum flow would increase during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow. Therefore, because water storage in Hell Hole Reservoir is sufficient to meet contractual obligations, and flows would not be reduced in the Middle Fork River below Oxbow Powerhouse or in the North Fork American River, water availability or the capability to divert the water would not change.

Hell Hole Reservoir Under the Proposed Action Alternative, storage at Hell Hole Reservoir would be reduced during the months of November and December 2008, relative to the No Action Alternative. Storage would decrease by up to 20,000 AF by the end of December 2008 based on information provided by PCWA. Under the No Action Alternative, end of December 2008 storage is expected to be approximately 104,100 AF, and 84,100 AF under the Proposed Action Alternative. However, it is uncertain whether any storage differences would remain subsequent to the 2008/2009 snow melt runoff period. Nonetheless, even if this minor reduction in storage were to carry over into the summer of 2009, it would not be expected to substantively reduce water supply availability. Examination of storage at Hell Hole Reservoir obtained from CDEC demonstrates that since 2000, end of December storage has ranged from 44,968 to 198,063 AF, and end of September storage has ranged from 37,600 to 150,900 AF. Therefore, under the Proposed Action Alternative, storage in Hell Hole Reservoir would remain well within historical ranges, and above FERC minimum specified storage levels.

No legal user of water would be injured because PCWA's transfer of water would only slightly increase, not decrease, streamflows below PCWA's MFP reservoirs. Any increase would be minor and would not cause any water flows to increase above normal seasonal levels, or to violate any regulatory requirements. The released water was stored by PCWA in accordance with its water rights and would not otherwise be available to any legal user of water. Additionally, PCWA would sign a reservoir refill agreement with Reclamation, ensuring that future refill of any storage space in PCWA's MFP reservoirs created by the transfer would not be with water that PCWA would not otherwise have been entitled to in accordance with its water rights.

The decrease in reservoir storage is equal to the water available for transfer (Section 2.1). The volume of water made available under the Proposed Action Alternative would not be of substantial magnitude, relative to the No Action Alternative, and therefore would not substantially affect water supply availability at Hell Hole Reservoir.

Folsom Reservoir Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 12,859 AF during November through December 2008. End of December 2008 storage in Folsom Reservoir is estimated to be 239,000 AF under the No Action Alternative, and 251,859 AF under the Proposed Action Alternative. Because no decreases in reservoir storage would occur under Proposed Action Alternative, water supply availability for CVP customers would not be decreased and there would be no effect to CVP customers.

Lower American River

Lower American River below Nimbus Dam Under the Proposed Action Alternative, the total release would be approximately 100 cfs higher from November 10 through December 15, 2008 than flows expected under the No Action Alternative in the lower American River below Nimbus Dam. Because no decreases in flow would occur under the Proposed Action Alternative, water supply availability to CVP customers or other legal users of water would not decrease and there would be no affect to CVP customers.

Sacramento River

The total transfer release under the Proposed Action Alternative would be approximately 100 cfs lower from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the Sacramento River below Keswick Dam. Flows on the lower Sacramento River (below the confluence with the lower American River) would not change under the Proposed Action Alternative, relative to the No Action Alternative. Also, water supply availability to CVP customers and other legal users of water would not decrease and there would be no affect to these customers.

Shasta Reservoir Shasta Reservoir storage is expected to increase by approximately 7,141 AF by the end of December 2008. Although flows below Keswick Dam would be reduced slightly (approximately 2.5 percent) during the months of November and December 2008 under the Proposed Action Alternative relative to the No Action Alternative, reservoir levels and river flows are anticipated to remain within normal flow ranges and fluctuations resulting from CVP operations. The slight reduction in flow released from Keswick Dam would result in flows remaining within the range needed to meet Wilkins Slough control point requirements. The projected minor flow changes are not expected to affect water supply availability to CVP customers or other legal users of water, under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento-San Joaquin Delta Inflows and Export Pumping

Under the Proposed Action Alternative, inflows into the Delta would not change relative to the No Action Alternative, because flows below the confluence of the lower American River and Sacramento River would not change. In addition to no change to Delta inflows, export pumping from the Jones and Banks pumping plants would not change during November 10 through December 15, 2008. The Proposed Action Alternative would give Reclamation some increased flexibility in managing river temperatures and summertime flows which would in turn allow for recovery of any reduced CVP export pumping in November and December. Therefore, changes in water supply availability to CVP customers would not occur under the Proposed Action Alternative relative to the No Action Alternative.

San Luis Reservoir

Under the Proposed Action Alternative, total storage in San Luis Reservoir would not change relative to the No Action Alternative. Operational assumptions include the consideration that the additional 7,141 AF of storage in Shasta Reservoir, and 12,859 AF in Folsom Reservoir on December 15, 2008 become integrated into overall CVP operations for the coming year.

Initially, CVP storage in San Luis Reservoir would be reduced by an amount equal to the volume of water pumped pursuant to this transfer. Over the course of the water year, Reclamation would opportunistically convey the increment of CVP water backed into storage that results from this action in a manner consistent with all applicable regulatory requirements. In the unlikely event that a combination of hydrologic conditions and/or fishery concerns does not allow for some increment of this water to be conveyed to San Luis Reservoir this water year, the WA contracts will include a provision where WWD and WWDD1 and Reclamation would make an exchange of a quantity of water to alleviate any CVP shortfall to other CVP customers south of the Delta. Therefore, changes would not occur to water supply availability to CVP customers under the Proposed Action Alternative relative to the No Action Alternative.

4.3.2 Summer 2009 Action Alternative

Middle Fork American River Project

The analysis of the potential changes in water availability associated with the Summer 2009 Action Alternative within the MFP are identical to those described for the Proposed Action Alternative (Section 4.3.1). Therefore, no changes in water supply availability would occur under the Summer 2009 Action Alternative relative to the No Action Alternative.

Hell Hole Reservoir Under the Summer 2009 Action Alternative, storage at Hell Hole Reservoir would be reduced during the months of November and December 2008, relative to the No Action Alternative, as described above for the Proposed Action Alternative. Because: (1) storage in Hell Hole Reservoir is sufficient to provide for the water transfer; (2) storage in Hell Hole Reservoir would remain well within historical ranges, and above FERC minimum specified storage levels; and (3) no legal user of water would be injured, the Summer 2009 Action Alternative relative to the No Action Alternative would not substantially affect water supply availability at Hell Hole Reservoir.

Lower American River

Folsom Reservoir Under the Summer 2009 Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 20,000 AF during November through December 2008. End of December 2008 storage in Folsom Reservoir is expected to be 239,000 AF under the No Action Alternative, and 259,000 AF under the Summer 2009 Action Alternative. The additional 20,000 AF of storage in Folsom Reservoir resulting from the implementation of the Summer 2009 Action Alternative would not reduce water supply to CVP customers. Moreover, in the event of that Folsom Reservoir spills during winter of

2008/2009, Reclamation policy requires that non-project water not displace project water. Therefore, reduction in water supply availability to CVP customers would not occur if Folsom Reservoir spills.

By the end of August 2009, storage in Folsom Reservoir is expected to be equivalent to the No Action Alternative. Because no decreases in reservoir storage or water supply availability to CVP customers would occur under the Summer 2009 Action Alternative relative to the No Action Alternative, no decreases in water supply availability at Folsom Reservoir would occur.

Lower American River below Nimbus Dam The total transfer release under the Summer 2009 Action Alternative would be approximately 163 cfs higher during July and August 2009 than flows expected under the No Action Alternative on the lower American River below Nimbus Dam. Because no decreases in flow would occur under the Summer 2009 Action Alternative, there would be no change to the water supply availability from the lower American River to CVP customers.

Sacramento River

Flows in the Sacramento River below Keswick Dam would not change during any month included in the assessment. In the lower Sacramento River below the confluence with the lower American River, flows would not change during any month included in the assessment with the exception of July and August 2009, when flows would increase 163 cfs under the Summer 2009 Action Alternative, relative to the No Action Alternative; therefore, there would be no change to the water supply availability in the lower Sacramento River (below confluence with the lower American River) to CVP customers...

Shasta Reservoir Shasta Reservoir storage would not change under the Summer 2009 Action Alternative relative to the No Action Alternative.

Therefore, no change to water supply availability to CVP customers would occur in Sacramento River and Shasta Reservoir under the Summer 2009 Action Alternative relative to the No Action Alternative.

Sacramento-San Joaquin Delta Inflows and Export Pumping

Inflows into the Delta would not change under the Summer 2009 Action relative to the No Action Alternative during any month included in the assessment, with the exception of July and August 2009, when inflows into the Delta would increase 163 cfs.

Export pumping from the Jones and Banks pumping plants would not change during any month included in the assessment, with the exception of July and August 2009, when export pumping from the Jones and Banks pumping plants would increase to amounts equal to 163 cfs minus carriage water costs (typically about 20 percent). The actual volume of export pumping is expected to be between 16,000 and 18,000 AF, resulting in an estimated increase in Delta export pumping of 130 to 146 cfs during July and August 2009. Therefore, no change to water supply availability to CVP customers would occur under the Summer 2009 Action Alternative relative to the No Action Alternative.

San Luis Reservoir

Under the Summer 2009 Action Alternative, storage in San Luis Reservoir could slightly and temporarily increase during July and August 2009 relative to the No Action Alternative. Therefore, no reductions in water supply availability to CVP customers would occur under the Summer 2009 relative to the No Action Alternative.

4.4 Surface Water Quality

4.4.1 Proposed Action

The analysis of potential changes in water quality associated with the proposed water transfer within the Middle Fork American River Basin was based on the following criteria:

- Decrease in end-of-month reservoir storage, of sufficient magnitude or duration relative to the No Action Alternative, to result in an increase in the concentration of contaminants.
- Decrease in monthly mean river flow, of sufficient magnitude or duration relative to the No Action Alternative, to result in an increase in the concentration of contaminants.

Middle Fork and North Fork American Rivers

Water quality in the American River is considered to be good, although historical water quality data for the North and Middle Forks of the American River are sparse (Corps 1991).

Because the Proposed Action Alternative would provide additional on-peak generation, the minimum and maximum flow rates for the day would remain the same as under the No Action Alternative, although the duration of the maximum flow would increase during the daily on-peak generation period. The volume of flow in the Middle Fork and North Fork American rivers during November and December 2008 would increase relative to the No Action Alternative. Therefore, flows would not decrease and would not result in an increase in the concentration of contaminants in the Middle Fork American River below Oxbow Powerhouse, or in the North Fork American River downstream of the confluence with the Middle Fork American River. Changes to water quality would not occur.

Hell Hole Reservoir Under the Proposed Action Alternative, storage at Hell Hole Reservoir would be reduced by up to 20,000 AF by the end of December 2008 relative to the No Action Alternative. However, it is uncertain whether any storage differences would remain subsequent to the 2008/2009 snow melt runoff period. Nonetheless, even if this minor reduction in storage carried over into the summer of 2009, it would not be expected to reduce storage to the extent that potential contaminant concentration would occur. Due to its position high in the watershed its inflow mainly comes from snowmelt, the reservoir does not receive a high level of contaminants, and water quality in Hell Hole Reservoir is generally considered to be good. Therefore, under the Proposed Action Alternative, water quality changes in Hell Hole Reservoir would not occur.

Historically, water quality parameters for the lower American River have typically been well within acceptable limits to achieve water quality objectives and beneficial uses identified for this waterbody (SWRCB 1998), and remain so today.

Lower American River

Folsom Reservoir Because no decreases in reservoir storage would occur under the Proposed Action Alternative relative to the No Action Alternative, there would be no notable degradation to the water quality in Folsom Reservoir. Moreover, the increases in reservoir storage may provide a slight improvement to the water quality in Folsom Reservoir by increasing the dilution of contaminants.

Lower American River below Nimbus Dam Under the Proposed Action Alternative there would be no decrease in flows along the lower American River below Nimbus Dam, relative to the No Action Alternative. Because no decreases in flows would occur under the proposed water transfer, there would be no change to the water quality in the lower American River below Nimbus Dam. Moreover, the increases in flows may provide slightly better water quality in the lower American River by increasing the dilution of contaminants.

Sacramento River

The total transfer release under the Proposed Action Alternative would be approximately 100 cfs lower from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the Sacramento River below Keswick Dam. Flows on the lower Sacramento River (below the confluence with the lower American River) would not change under the Proposed Action Alternative, relative to the No Action Alternative. Although flows below Keswick Dam would be reduced slightly (approximately 2.5 percent) during the months of November and December 2008 under the Proposed Action Alternative relative to the No Action Alternative, river flows are anticipated to remain within normal flow ranges and fluctuations resulting from CVP operations. The minor reduction in flows from Keswick Dam to the confluence with the lower American River associated with the Proposed Action Alternative relative to the No Action Alternative would not be expected to result in a substantive increase in the concentration of contaminants. Downstream of the confluence with the lower American River flows would not change and contaminant concentrations would not be affected. Therefore, implementation of the Proposed Action Alternative relative to the No Action Alternative is not expected to affect water quality in the Sacramento River.

Shasta Reservoir Under the Proposed Action Alternative relative to the No Action Alternative, Shasta Reservoir storage is expected to increase by approximately 7,141 AF by the end of December 2008. Therefore, changes to water quality (increase in the concentration of contaminants in the reservoir) in Shasta Reservoir would not occur.

Sacramento-San Joaquin Delta Inflows and Export Pumping

WWD and WWDD1 provide water to their customers for a variety of uses, primarily for agriculture. Reclamation is responsible for mitigating its water quality effects as required under the 2006 Bay-Delta Water Quality Control Plan (SWRCB 2006). Under the Proposed Action Alternative relative to the No Action Alternative, there would be no change to Delta inflows or export pumping during any of the months evaluated. Therefore, Reclamation's ability to meet the 2006 Bay-Delta Water Quality Control Plan objectives would not be compromised. No changes to water quality are expected to occur as a result of the Proposed Action Alternative relative to the No Action Alternative.

San Luis Reservoir
Under the Proposed Action Alternative, San Luis Reservoir storage would not change relative to the No Action Alternative. Therefore, the concentration of contaminants in San Luis Reservoir would not change under the Proposed Action Alternative relative to the No Action Alternative.

4.4.2 Summer 2009 Action Alternative
The analysis of potential changes in water quality associated with the water transfer within the Middle Fork American River Basin under the Summer 2009 Action Alternative was based on the same criteria as the Proposed Action Alternative.

Middle Fork and North Fork American Rivers
Water quality effects for the Middle Fork and North Fork American Rivers, including French Meadows, Hell Hole and Folsom reservoirs, under the Summer 2009 Action Alternative relative to the No Action Alternative would be same as those described for the Proposed Action Alternative.

Lower American River
Water quality effects for the lower American River below Nimbus Dam, under the Summer 2009 Action Alternative relative to the No Action Alternative would be same as those described for the Proposed Action Alternative.

Sacramento River
Under the Summer 2009 Action Alternative relative to the No Action Alternative, storage in Shasta Reservoir would remain the same for all months evaluated. Therefore, changes to water quality would not occur in Shasta Reservoir.

Shasta Reservoir Under the Summer 2009 Action Alternative relative to the No Action Alternative, flows in the Sacramento River below Keswick Dam to the confluence with the lower American River would remain the same for all months evaluated. Therefore, potential increase in the concentration of contaminants in this section of the Sacramento River would not occur, and water quality would not be affected. In the Sacramento below the confluence with the lower American River, flows would remain the same for all months evaluated with the exception of July and August 2009. During July and August 2009 flows in this section of the lower Sacramento River would increase slightly (163 cfs). Therefore, these slight increases in flows would not result in the concentration of contaminants in the lower Sacramento River, and may provide a slight water quality improvement.

Sacramento-San Joaquin Delta Inflows and Export Pumping
Under the Summer 2009 Action Alternative, relative to the No Action Alternative, Delta inflows and export pumping would not change for any months evaluated except for July and August 2009. During July and August 2009, Delta inflows would increase by approximately 163 cfs associated with the releases from Folsom Reservoir. The relatively high quality water from Folsom Reservoir and the minor increases in flows would not result in concentration of contaminants, and may have slight beneficial effects to Delta water quality. Total export pumping during July and August 2009 associated with the Summer 2009 Action Alternative would be expected to increase from 130 to 146 cfs due to carriage water losses relative to the No Action Alternative. The minor amount of increase in Delta inflows, in combination with a

lesser increase in export pumping, would not be expected to change water quality in the Delta.

San Luis Reservoir

Under the Summer 2009 Action Alternative, storage in San Luis Reservoir could slightly and temporarily increase during July and August 2009 relative to the No Action Alternative. The slight increase in storage in San Luis Reservoir may reduce water quality deterioration caused by a combination of high water temperatures, wind-induced nutrient mixing, and algal blooms near the reservoir surface in the summer months. Therefore, the concentration of contaminants in San Luis Reservoir would not increase under the Summer 2009 Action Alternative relative to the No Action Alternative.

4.5 HydroPower

Potential power supply effects include changes in CVP hydroelectric power generation and capacity, changes in pumping energy use by diverters that pump water from Folsom Reservoir, and changes to energy use within the project area. No other potential effects on power generation or demand are anticipated with the exception of potential increases in the use of energy resources for pumping and conveyance of the transfer water.

Reduction in CVP generation would be a cost effect either because Western would be precluded from selling excess energy or would be required to purchase additional energy for its customers.

4.5.1 Proposed Action

Middle Fork and North Fork American Rivers

Middle Fork Project Hydropower Generation The typical monthly demand pattern included in the Proposed Action Alternative is consistent with the allowable monthly distribution of diversions as specified in the power purchase agreement between PCWA and PG&E. The release of surface water from the MFP would generate increased power production under the Proposed Action Alternative, relative to the No Action condition. Increased flows through the French Meadows, Hell Hole, and Oxbow power plants would be used for power generation, first to increase the number of hours of on-peak generation, then to increase off-peak generation, and would allow PG&E to produce additional power. The Oxbow Power Plant is used at full capacity of about 1,000 cfs during the on-peak hours, which are typically daytime hours (especially afternoon and evening), and reduced for the rest of the day. Water transferred under the Proposed Action Alternative would result in the powerhouse being used at capacity for more time during the day. The minimum and maximum flow rates for the day would remain the same; only the duration of the maximum flow would increase with implementation of the Proposed Action Alternative, relative to the No Action condition. Combined power generation at the French Meadows, Hell Hole, and Oxbow power plants would be greater with implementation of the Proposed Action Alternative relative to the No Action Alternative.

Lower American River

Folsom and Nimbus Power Plants With implementation of the Proposed Action Alternative, Folsom Reservoir storage and surface water elevations would slightly increase during November and December 2008, relative to the No Action Alternative. Releases would increase from Folsom Reservoir which would increase hydropower generation at the Folsom or Nimbus power plants.

Folsom and El Dorado Irrigation District Pumping Plants The Folsom Pumping Plant and the El Dorado Irrigation District (EID) Pumping Plant lift water from Folsom Reservoir up to treatment plants for treatment and distribution. The Proposed Action Alternative would result in slightly increased water surface elevations in Folsom Reservoir. Increased water surface elevations translate into reduced energy requirements for pumping (reduced head). Therefore, less pumping energy would be needed with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

Sacramento River

Shasta and Keswick Power Plants Under the Proposed Action Alternative, Shasta and Keswick power generation would slightly decrease during November and December 2008, relative to the No Action Alternative. This decrease in generation would be recovered at a later date with release of the water stored in Shasta Reservoir under the Proposed Action Alternative relative to the No Action Alternative. Therefore, no notable change in overall power generation would occur with implementation of the Proposed Action Alternative, relative to the No Action Alternative.

Sacramento-San Joaquin Export Pumping

Under the Proposed Action Alternative, the volume of export pumping in November and December 2008 remains unchanged, relative to the No Action Alternative. However, the water being pumped in the Proposed Action Alternative is non-CVP water and the associated pumping energy costs would be borne by WWD & WWDD1 using commercial energy provided by the existing power grid. As a consequence CVP Project Energy use would not increase. Therefore, there would be no change in CVP pumping energy use with implementation of the Proposed Action Alternative, relative to the No Action Alternative.

San Luis Reservoir

O'Neill, Dos Amigos, and Gianelli Pumping Plants Under the Proposed Action Alternative, pumping volumes remain unchanged, relative to the No Action Alternative. However, the water being pumped in the Proposed Action Alternative is non-CVP water and the associated pumping energy costs would be borne by WWD & WWDD1using commercial energy provided by the existing power grid. As a consequence CVP Project Energy use would not increase, providing no effect to CVP Preference Power customers with the implementation of the Proposed Action Alternative relative to the No Action Alternative.

Under the Proposed Action Alternative, minor shifts in CVP operations would affect the hydropower operations. During November and December 2008, these operational changes would result in: (1) a shifting of hydropower generation from Shasta and Keswick power plants to Folsom and Nimbus power plants; and (2) a reduction in CVP project use power at CVP pumping plants. With the release of the stored Shasta Reservoir water at a later date, a slight increase in power generation would be realized along with a slight increase in project use for CVP pumping. The combined effect of these changes is expected to be a slight benefit to CVP power.

4.5.2 Summer 2009 Action Alternative

Middle Fork and North Fork American Rivers

Middle Fork Project Hydropower Generation MFP hydropower operations for the Summer 2009 Action Alternative would be the same as the Proposed Action Alternative. Therefore, MFP power generation would be greater with implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

Lower American River

Folsom and Nimbus Power Plants Under the Summer 2009 Action Alternative, relative to the No Action Alternative, Folsom and Nimbus releases would not change for any months evaluated except for July and August 2009. During July and August 2009, Folsom and Nimbus releases would increase by approximately 163 cfs. For the entire period of November 2008 through August 2009, Folsom Reservoir water surface elevation would be higher than the No Action Alternative. The increase in releases and higher head would provide an increase in hydropower generation during July and August 2009.

Therefore, a slight increase in CVP power generation at Folsom and Nimbus power plants would be anticipated with implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

Folsom and EID Pumping Plants The Summer 2009 Action Alternative would result in increased water surface elevations in Folsom Reservoir from November 2008 through August 2009 and reduced pumping head for the Folsom and EID pumping plants. The reduced pumping head would decrease the amount of energy required for pumping. Therefore, energy use would decrease with implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

Sacramento River

Shasta and Keswick Power Plants Under the Summer 2009 Action Alternative, Shasta and Keswick releases would not change relative to the No Action Alternative. Power generation would not change relative to the No Action Alternative. Therefore, no change to power generation would occur with implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

Sacramento-San Joaquin Export Pumping

Under the Summer 2009 Action Alternative, relative to the No Action Alternative, Delta export pumping would not change for any months evaluated except for July and August 2009. Total export pumping during July and August 2009 associated with the Summer 2009 Action Alternative would be expected to increase from 130 to 146 cfs (163 cfs minus estimated carriage water losses) relative to the No Action Alternative. However, the water being pumped in the Summer 2009 Action Alternative is non-CVP water and the associated pumping energy costs would be borne by WWD & WWDD1 using commercial energy provided by the existing power grid. As a consequence CVP Project Energy use would not change under the Proposed Action Alternative relative to the No Action Alternative.

San Luis Reservoir

O'Neill, Dos Amigos, and Gianelli Pumping Plants Under the Summer 2009 Action Alternative, pumping volumes in July and August 2009 could slightly increase, relative to the No Action Alternative. However, the water being pumped in the Summer 2009 Action Alternative is non-CVP water and the associated pumping energy costs would be borne by WWD & WWDD1 using commercial energy provided by the grid. As a consequence CVP Project Energy use would not increase. Therefore, there would be no effect on pumping energy with implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

Under the Summer 2009 Action Alternative, no notable hydropower effects are anticipated, relative to the No Action Alternative.

4.6 Fisheries and Aquatic Resources

The analysis of potential effects on fisheries and aquatic resources includes an assessment of the fisheries of French Meadows, Hell Hole, Folsom, Shasta, and San Luis reservoirs; an assessment of fishery resources of the Middle Fork American River below Oxbow Powerhouse, the North Fork American River below the confluence with the Middle Fork American River; the lower American River below Nimbus Dam to its confluence with the Sacramento River; the Sacramento River (upper and lower); and the Delta.

The analysis of the potential effects on fisheries and aquatic resources associated with the action alternatives was based on criteria specific for the following waterbodies.

4.6.1 Reservoirs

To evaluate the potential effects of the proposed water transfer on reservoir fisheries, seasonal changes in storage under the No Action Alternative (i.e., without transfer) and the action alternatives (i.e., with transfer) conditions was examined. The values for reservoir end-of-month storage at French Meadows and Hell Hole reservoirs were determined from the PG&E monthly operations forecast. End-of-month storage at Folsom, Shasta, and San Luis reservoirs under the No Action Alternative was obtained from Reclamation's operations forecast. Differences in end of month storages between the action alternatives and the No Action Alternative were used to evaluate the potential for reduced physical habitat availability and coldwater pool volume in Action Area reservoirs. Also, using reservoir specific area–capacity curves, estimates for storage changes were translated into relative changes in water surface evaluations. The estimated values for changes in water surface elevations were used to examine the potential for increases in the frequency of warmwater fish nest-dewatering events.

Cold Water Fisheries

During the period when Action Area reservoirs are thermally stratified (generally April to November), coldwater fish in the reservoir reside primarily within the reservoir's metalimnion (middle of the reservoir) and hypolimnion (near bottom) where water temperatures remain suitable. Reduced reservoir storage during this period could reduce the reservoir's coldwater pool volume, thereby reducing the quantity of habitat available to coldwater fish species during these months. Reservoir coldwater pool size generally decreases as reservoir storage decreases, although not always in direct proportion because of the influence of reservoir basin morphomentry. Therefore, to assess potential storage-related effects to coldwater fish habitat availability in French Meadows, Hell Hole, Folsom, Shasta and San Luis reservoirs, end-of-month storage for each reservoir under the action alternatives was compared to end-of-month storage under the No Action Alternative for each month of the April to November period. Substantial reductions in reservoir storage were considered to result in substantial reductions in coldwater pool volume and, therefore, habitat availability for coldwater fish.

The criteria used to evaluate potential effects to the coldwater fisheries in Action Area reservoirs are as follows:

- Decrease in reservoir storage, which also would reduce the coldwater pool, relative to the No Action Alternative, of sufficient magnitude or duration to adversely affect coldwater fish during the April to November period.

Warmwater Fisheries

Because warmwater fish species in reservoirs (including black bass, largemouth bass, smallmouth bass, spotted bass, green sunfish, crappie, and catfish) use the warm upper layer of the reservoirs and nearshore littoral habitats throughout most of the year, seasonal changes in reservoir storage, as it affects reservoir water surface elevation (feet msl), and the rates at which water surface elevation change during specific periods of the year, can directly affect the reservoir's warmwater fish resources. Reduced water surface elevations can potentially reduce the availability of nearshore littoral habitats used by warmwater fish for rearing, thereby potentially reducing rearing success and subsequent year-class strength. In addition, decreases in reservoir water surface elevation during the primary spawning period for warmwater fish nest building may result in reduced initial year-class strength through warmwater fish nest "dewatering."

Given the differences in geography and altitude among the reservoirs within the Action Area, warmwater fish spawning and rearing periods vary somewhat among reservoirs. Although black bass spawning may begin as early as February, or as late as May, in various California reservoirs, and may possibly extend to July in some waters, the majority of black bass and other centrarchid spawning in California occurs from March through May (Lee 1999; Moyle 2002). However, given the geographical and altitudinal variation among the Action Area reservoirs, in order to examine the potential of nest dewatering events to occur, the warmwater fish-spawning period is assumed to extend from March through June. Additionally, to encompass all reservoirs included in the Action Area, the period of April through November is appropriate for assessing effects on warmwater juvenile fish rearing.

Review of the available literature suggests that, on average, self-sustaining black bass populations in North America experience a nest success (i.e., the nest produces swim-up fry) rate of 60 percent (Friesen 1998; Goff 1986; Hunt and Annett 2002; Hurley 1975; Knotek and Orth 1998; Kramer and Smith 1962; Latta 1956; Lukas and Orth 1995; Neves 1975; Philipp et al. 1997; Raffetto et al. 1990; Ridgway and Shuter 1994; Steinhart 2004; Turner and MacCrimmon 1970). A study by CDFG, which examined the relationship between reservoir water surface elevation fluctuation rates and nesting success for black bass, suggests that a reduction rate of approximately six feet per month or greater would result in

60 percent nest success for largemouth bass and smallmouth bass (Lee 1999). Therefore, a decrease in reservoir water surface elevation of six feet or more per month is selected as the threshold beyond which spawning success of nest-building, warmwater fish could potentially result in population declines.

To evaluate potential effects on largemouth bass, smallmouth bass, and ultimately warmwater fish in general, the frequency of occurrence of month-to-month (March through June) reservoir reductions of six feet or more under the action alternatives relative to the No Action Alternative was examined.

The criteria used to evaluate potential effects on the warmwater fisheries in Action Area reservoirs are as follows:

- Additional decreases in month-to-month reservoir water surface elevations of more than six feet per month, under the action alternatives relative to the No Action Alternative, of sufficient frequency to reduce warmwater fish spawning success over the March through June extended spawning period.
- Additional decreases in water surface elevations of sufficient magnitude from April through November to appreciably reduce the availability of nearshore littoral habitats used by warmwater fish for rearing, thereby potentially reducing rearing success and subsequent year-class strength of warmwater juvenile fish rearing under the action alternatives relative to the No Action Alternative.

4.6.2 Rivers

Instream flow and water temperature are important parameters related to the production and condition of aquatic resources in riverine environments. Instream flow, and the magnitude and duration of flow fluctuation events, may affect fish populations, particularly salmonid populations, by determining the amount of available habitat or altering the timing of life history events (e.g., spawning). Rapid changes in flow have the potential to affect the survival of eggs and alevins by exposing redds, and rapidly receding flow conditions may strand juveniles in pools and side channels or on beach substrates where desiccation, rapidly increasing water temperature, and predation may affect overall survival. In addition, water temperatures influence metabolic, physiologic, and behavioral patterns, as well as fecundity and overall spawning success of fish populations (SWRI 2003).

The general criteria used to evaluate potential effects to fisheries and other aquatic resources in the Action Area rivers are as follows:

- Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce the habitat suitability of river fisheries and aquatic resources, or result in redd dewatering or juvenile stranding.

In the lower American and Sacramento rivers, evaluation of potential effects resulting from changes in river flows and water temperature under the action alternatives relative to the No Action Alternative focused on the species of primary management concern (e.g., anadromous salmonids and green sturgeon). Because anadromous salmonids (i.e., winter-run Chinook salmon, spring-run Chinook salmon, fall/late fall-run Chinook salmon, and steelhead) are known to use the lower American River and Sacramento Rivers during discrete time periods associated with specific lifestages, potential effects were evaluated using species-specific assessment parameters, where appropriate.

The effects analysis focused on determining potential effects to anadromous salmonids because their life history requirements are generally more restrictive than those of other fish species found in the rivers. Thus, if anadromous salmonids are not affected by the action alternatives relative to the No Action Alternative, it is unlikely that other, less sensitive fish species (e.g., splittail, American shad and striped bass) would be affected. The criteria used to evaluate potential effects on anadromous salmonids in the lower American and Sacramento rivers are as follows:

- Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to notably reduce the suitability of habitat conditions during adult immigration.
- Decrease in river flows or increase in water temperatures, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce spawning habitat availability and incubation.
- Decrease in flow and associated decrease in stage, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to notably increase redd dewatering or juvenile stranding.
- Decrease in flow or increase in water temperature, under the action alternatives relative to the No Action Alternative, of sufficient magnitude or duration to appreciably reduce the suitability of habitat conditions during juvenile rearing.

In the Sacramento River, similar considerations were included in the effects assessment for green sturgeon.

4.6.3 Sacramento-San Joaquin Delta

Hydrological evaluation provides the technical foundation for assessing effects of CVP operations on fish species and their habitat within the Delta. The assessment relies on a comparative analysis of changes in Delta parameters under action alternatives relative to the No Action Alternative, using Reclamation's forecasted operations for 2008 and 2009. The potential for CVP operations associated with the action alternatives to affect Delta fisheries resources is examined by: (1) modifying habitat quality and availability for various fish species within the Delta; and (2) altering fish mortality resulting from CVP export pumping operations from the south Delta.

The hydrological evaluation provides monthly data that is used as part of a general evaluation of potential effects of project operations on habitat quality and availability for various fish and aquatic resources inhabiting the Bay-Delta estuary. The results also can be used to estimate potential fish salvage, based upon historical estimates of fish density at CVP salvage facilities, for use as part of this effect assessment. Evaluation parameters selected for part of this evaluation include:

- Location of the two-part per thousand salinity isohaline (X2);
- Delta outflow;
- E/I ratio; and
- Fish salvage at the Tracy and Skinner fish facilities

The USFWS, CDFG, NMFS, and others have established biological relationships based upon results of fisheries investigations conducted for use in evaluating the biological effects of changes in many of the habitat-related parameters that could be affected by implementation of the action alternatives relative to the No Action Alternative. However, biological relationships have not been established for some of the indices, such as the E/I ratio. Hence, findings of the effects assessment are based on a combination of established biological relationships, the best available scientific information on the life history periodicities and habitat requirements for various species, regulatory requirements, and the results of the hydrologic evaluation.

Sacramento-San Joaquin Delta X2 Location

The SWRCB D-1641 requires the X2 location to meet certain objectives from February through June. The location of X2 within Suisun Bay during the February through June period is thought to be directly or indirectly related to the reproductive success and survival of the early life stages for several estuarine species. Results of statistical regression analysis suggest that abundances of several estuarine species are greater during the spring when the location of X2 is within the western portion of Suisun Bay (e.g., Roe Island [River Kilometer (RKm) 64]), with lower abundances correlated with those years when the location of X2 location is farther to the east near the confluence (RKm 81) of the Sacramento and San Joaquin rivers (YCWA *et al.* 2003). A location of X2 near Chipps Island (RKm 74) could result in a distribution pattern where more estuarine species would be susceptible to entrainment and elevated mortality in the central and south Delta due to predation or relatively high water temperatures. The standards related to the location of X2 in the Bay-Delta Plan and SWRCB D-1641 also are intended to protect Delta resources by providing adequate transport flows to move Delta fisheries away from the influence of the CVP (and SWP) water diversion facilities into low-salinity rearing habitat in Suisun Bay and the lower Sacramento River (USFWS 2004).

Although the Bay-Delta Plan water quality objectives and SWRCB D-1641 requirements contain X2 objectives only for February through June, changes in monthly mean X2 locations are evaluated in this EA for all months of each year because the Delta provides year-round habitat for one or more life stages of various species.

The February through July period encompasses the peak delta smelt spawning period, and delta smelt larvae and juveniles are reported to be vulnerable to entrainment and elevated water temperatures from March through July. Upstream movements of X2 can cause delta smelt to become more susceptible to entrainment in the south Delta during March through July, and expose them to potentially lethal water temperatures during June through July (USFWS 2004).

Because many fish and aquatic resources inhabit the Delta estuary year-round, while other species inhabit the estuary on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing, the Delta analysis in this EA considers all months of the year. Although there are similarities in life stage timing and species specific estuarine habitat utilization reported in the literature, there are variations in run-specific outmigration patterns for species such as Chinook salmon. Winter-run Chinook salmon primarily migrate through the Delta from December through April (Reclamation 2004). The emigration period for spring-run Chinook salmon extends from November through early May (NMFS 2004a). Hallock (1961) found that juvenile steelhead in the Sacramento River Basin migrate downstream during most months of the year, but the peak emigration period occurs in the spring (NMFS 2004a).

Sacramento-San Joaquin Delta Outflow

The Bay-Delta Plan also established Delta outflow objectives for all months of the year. The Bay-Delta Plan states that… "Delta outflow objectives are included for the protection of estuarine habitat for anadromous fishes and other estuarine-dependent species." Seasonal flows influence the transport of eggs and young organisms through the Delta and into San Francisco Bay. Flows during the months of April, May, and June play an especially important role in determining the reproductive success and survival of many estuarine species including salmon, striped bass, American shad, delta smelt, longfin smelt, splittail, and others (Stevens and Miller 1983; Stevens et al. 1985; Herbold 1994; Meng and Moyle 1995 as cited in (DWR and Reclamation 1996b)). For the February though June period, Delta outflow objectives are met by compliance with the X2 objective. Potential effects on delta smelt associated with changes in Delta outflow under the Project, relative to the bases of comparison, are assessed utilizing the X2 analyses.

Changes in Delta outflow may affect the availability and quality of estuarine habitat, particularly during the late winter and spring months, which are thought to be important for survival and growth of a variety of fish and aquatic resources. In addition, the length of time juvenile Chinook salmon spend in the lower rivers and the Delta varies depending on the outflow, the times of year the salmon migrate, and the development stages of the fish (Kjelson et al. 1982 in Reclamation 2004). Residence time tends to be shorter during periods of high flow relative to periods of low flow. Analyses in this document include examination of monthly changes in Delta outflow under the action alternatives relative to the No Action Alternative, using Reclamation's operational forecast for 2008 and 2009.

Sacramento-San Joaquin Delta Export-to-Inflow Ratio

The ratio between CVP and SWP exports and freshwater inflow to the Delta from the Sacramento and San Joaquin river systems (the E/I ratio) has been used to assess potential operational effects on Bay-Delta habitat conditions. Relationships between E/I ratios and resulting changes in biological response, such as abundance or geographic distribution, or increases in vulnerability to CVP and SWP salvage, have not been established. However, the framework for environmental analyses has typically assumed that a higher export rate relative to freshwater inflow, on a seasonal basis, the higher the probability of adverse effects on geographic distribution or salvage losses as a result of export operations. E/I ratio limits specified in the Bay-Delta Plan and SWRCB D-1641 are intended to protect Delta fishes by limiting their susceptibility to entrainment and elevated mortality in the Delta.

Analyses in this EA include examination of monthly changes in E/I ratios under the action alternatives relative to the No Action Alternative.

Salvage at the CVP and SWP Export Facilities in the Sacramento-San Joaquin Delta

The CVP (and SWP) export facilities that pump water from the Delta can directly affect fish mortality in the Delta through entrainment and associated stresses. Salvage operations at the CVP and SWP facilities (i.e., Tracy and Skinner fish collection facilities) are performed to reduce the number of fish adversely affected by entrainment. Salvage estimates are defined as the number of fish entering a salvage facility, and salvaged fish are subsequently returned to the Delta through a trucking and release operation. Because the survival of species that are sensitive to handling is believed to be low for many fish species, increased salvage is potentially considered an adverse effect and decreased salvage is considered a beneficial effect on Delta fisheries resources.

Fish salvage operations are conducted daily at the Tracy and Skinner fish salvage facilities for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, striped bass, and delta smelt, as well as numerous other species. An expanded (or total) daily salvage estimate for each species is determined at each fish salvage facility using a sub-sampling protocol which considers: (1) species-specific sub-sampling salvage count; (2) length of the sub-sampling period; and (3) length of the total daily pumping period.

Consistent with Reclamation's OCAP Biological Assessment (BA), it is assumed that changes in salvage are directly proportional to changes in the amount of water pumped (i.e., doubling the amount of water exported doubles the number of fish salvaged). Hence, the changes in fish salvaged at the export facilities as a result of the action alternatives are estimated by multiplying the species-specific monthly salvage rate by the percent change in the volume of water pumped during a particular time period under the action alternatives, relative to the No Action Alternative. The resulting values indicate the addition or reduction of fish expected to be salvaged at the export facilities with implementation of the action alternatives, relative to the No Action Alternative.

4.6.4 Proposed Action

Middle Fork and North Fork American Rivers

Operations of the MFP under existing conditions currently result in highly variable flows on a daily and weekly basis. The overall general increased discharge under the action alternatives, relative to the No Action Alternative, would result in a temporal increase in exposure to higher average daily flows, thus decreasing the amount of time that fish and other aquatic organisms are exposed to daily base flow conditions during November and December 2008. The increased flow could enhance instream habitat conditions for rainbow and brown trout, a primary component of the coldwater fishery in the Middle Fork American River. Also, changes in the flow regime associated with the action alternatives related to the No Action Alternative could increase the forage base of fish species in the Middle Fork American River.

Periodic dewatering of the stream margins during hydroelectric peaking operations has been shown to limit the ability of aquatic invertebrates to colonize these areas and achieve the densities that occur in areas that are constantly submerged (Gislason 1985). Differences in flow regime may provide a partial explanation for somewhat higher aquatic invertebrate diversity (taxa richness) in the control reaches where flows are relatively stable during the summer and fall. Aquatic invertebrates such as stoneflies, which may contribute to the forage base for fish, are more likely to successfully colonize and reproduce in an environment with more stable flow conditions.

Flows under the action alternatives would not fluctuate beyond existing minimum and maximum ranges. Therefore, no effects to aquatic macroinvertebrate habitat availability are anticipated, relative to the No Action Alternative. The increased flow releases under the action alternatives would not increase the magnitude of flows in the Middle Fork American River and therefore, would not affect benthic macroinvertebrate assemblages, relative to the No Action Alternative. Also, the magnitude or velocity of flow releases under the action alternatives would not increase above current peaking levels; therefore, there is no additional risk of potentially disrupting or displacing benthic macroinvertebrates or suitable habitat, relative to the No Action Alternative.

It is anticipated that the released water temperatures from Oxbow Powerhouse would not notably change with the implementation of the action alternatives relative to the No Action Alternative. Also, during fall and winter months in the foothill region of the Sierra Nevada, ambient climatic conditions strongly influence downstream water temperatures. Therefore, it is expected that water temperatures in the Middle Fork American River below Oxbow Powerhouse would not noticeably change with the implementation of the action alternatives, relative to the No Action Alternative.

Similar, but less observable changes in flow and water temperature would be expected to occur in the North Fork American River due to flow attenuation. Therefore, changes in flow and water temperature during November and December 2008 associated with the action Alternatives relative to the No Action Alternative would not result in appreciably effects to fisheries and aquatic resources in Middle Fork and North Fork American rivers.

Hell Hole Reservoir Under the Proposed Action Alternative, storage at Hell Hole Reservoir would be reduced during November and December 2008, relative to the No Action Alternative. Storage would decrease by up to 20,000 AF by the end of December 2008 based on information provided by PCWA. Under the No Action Alternative, end of December 2008 storage is expected to be approximately 104,100 AF, and 84,100 AF under the Proposed Action Alternative. However, it is uncertain whether any storage differences would remain subsequent to the 2008/2009 snow melt runoff period. Nonetheless, even if this minor reduction in storage were to carry over into the summer of 2009, it would not be expected to substantively reduce water storage. Examination of storage at Hell Hole Reservoir obtained from CDEC demonstrates that since 2000, end of December storage has ranged from 44,968 to 198,063 AF, and end of September storage has ranged from 37,600 to 150,900 AF. Under the Proposed Action Alternative, storage in Hell Hole Reservoir would remain well within historical ranges, and above FERC minimum specified storage levels.

Coldwater Fisheries Hell Hole Reservoir supports coldwater recreational fisheries for resident rainbow and brown trout, and may also support lake trout and Kokanee salmon populations. The anticipated decreases in reservoir storage would not be expected to notably affect the reservoir's coldwater fisheries because: (1) coldwater habitat would remain available within the reservoir during all months of the April through November period; (2) physical habitat availability would not be substantively reduced; and (3) anticipated seasonal reductions in storage would not be expected to notably affect the primary prey species utilized by coldwater fishes. Therefore, changes in end-of-month storage under the Proposed Action Alternative relative to the No Action Alternative would not result in effects to coldwater fish resources in Hell Hole Reservoir.

Warmwater Fisheries Warmwater fisheries also are reported to exist in Hell Hole Reservoir, including smallmouth bass, catfish, and sunfish. Fish production in the reservoir is believed to be limited by relatively cold water temperatures and large seasonal fluctuations in water levels and low productivity compared to natural lakes (Jones and Stokes 2001).

Under the No Action Alternative, end of December 2008 storage is expected to be approximately 104,100 AF, and 84,100 AF under the Proposed Action Alternative. Application of area-capacity curves indicates that this 20,000 AF storage reduction would correspond to an approximate reduction in the end of December 2008 water surface elevation of 25 feet. However, the spawning period for warmwater fish is believed to generally extend from March through June.

It is uncertain whether any storage differences would remain subsequent to the 2008/2009 snow melt runoff period. Nonetheless, even if the end of December 2008 reduction in water surface elevation were to carry over into the spring of 2009, it would simply result in a different boundary condition for water surface elevation at which warmwater fish nest building would occur, and reductions during the warmwater fish spawning period itself would not be expected to occur with implementation of the Proposed Action Alternative relative to the No Action Alternative. Similarly, anticipated reductions in water surface elevations associated with the Proposed Action Alternative relative to the No Action Alternative would not be expected to be of sufficient magnitude or duration to notably affect the April through November availability of nearshore littoral habitats used by warmwater fish for rearing. Consequently, potential reductions in water surface elevations under the Proposed Action Alternative relative to the No Action Alternative would not be expected to appreciably affect the warmwater fisheries in Hell Hole Reservoir.

Lower American River

The total transfer release under the Proposed Action Alternative would be approximately 100 cfs higher from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the lower American River below Nimbus Dam. Following is a discussion of potential effects to various fish species/life stages associated with these changes in flow.

In addition to flow, water temperature is an important consideration for the lower American River, particularly for fall-run Chinook salmon and steelhead. Seasonal releases from Folsom Reservoir's coldwater pool influence thermal conditions for the lower American River.

Folsom Reservoir's coldwater pool oftentimes is not large enough to allow for coldwater releases during the warmest months (i.e., July through September) to provide maximum thermal benefits to steelhead, and coldwater releases during October and November for fall-run Chinook salmon immigration, spawning, and incubation.

It is presently anticipated that during November 2008, hydropower generation releases would be bypassed by not drawing water from the power penstock intake structure; rather, water would be released from Folsom Reservoir via the lower river outlets to access the relatively cold, hypolimnetic water for fall-run Chinook salmon spawning.

Adult Fall-run Chinook Salmon/Steelhead Immigration Adult upstream immigration of fall-run Chinook salmon generally occurs from August through December, whereas steelhead adult immigration generally occurs from December into March, which includes the period of changes in flow released from Nimbus Dam associated with the Proposed Action Alternative relative to the No Action Alternative. The increased flow rates associated with the Proposed Action Alternative relative to the No Action Alternative in the lower American River below Nimbus Dam would not be expected to reduce the attraction of adults immigrating into the lower American River, nor be of sufficient magnitude to encourage additional straying into the lower American River. Although physical passage impediments are not believed to occur in the lower American River, increased flows (100 cfs) associated with the Proposed Action Alternative have the potential to facilitate the upstream migration of adult fall-run Chinook salmon and steelhead.

It is anticipated that the release water temperatures from Nimbus Dam would not appreciably change with the implementation of the Proposed Action Alternative relative to the No Action Alternative. Also, from mid-November to mid-December in the lower American River, ambient climatic conditions strongly influence downstream water temperatures. Therefore, it is expected that water temperatures in the lower American River would not noticeably change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

During the adult fall-run Chinook salmon and steelhead adult immigration periods potentially affected by the Proposed Action Alternative relative to the No Action Alternative, changes in river flow or water temperature of sufficient magnitude or duration would not occur in the lower American River to affect adult immigration.

Adult Fall-run Chinook Salmon Spawning and Egg Incubation Fall-run Chinook salmon spawning in the lower American river generally occurs from October to December, which encompasses the period when flow changes could be expected under the Proposed Action Alternative relative to the No Action Alternative. Examination of the spawning habitat- flow relationships developed through 2-D modeling (USFWS 2003) indicate that fall-run Chinook salmon spawning habitat would slightly increase associated with the 100 cfs increase in flow under the Proposed Action Alternative relative to the No Action Alternative.

Also, the increase in inflow to Folsom Reservoir during November and December, under the Proposed Action Alternative relative to the No Action Alternative, is not expected to decrease coldwater pool availability in Folsom Reservoir, nor affect the efficacy of the anticipated hydropower bypass release during fall 2008. It is anticipated that the boundary condition release water temperatures from Nimbus Dam would not notably change with the implementation of the Proposed Action Alternative relative to the No Action Alternative. Also, from mid-November to mid-December in the lower American River, ambient climatic conditions strongly influence downstream water temperatures. Therefore, it is expected that water temperatures in the lower American River would not notably change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

At the end of the Proposed Action Alternative water transfer period on December 15, 2008, flows would be reduced from 1,100 to 1,000 cfs. Although it is recognized that stage-discharge relationships are site specific and can vary along the lower American River, an overall general relationship suggests that a stage change of about 1.5 inches could occur for every 100 cfs change. Reduction in flow at the cessation of the transfer period could result in a stage change in the lower American River of about 1.5 to 2 inches.

Examination of the cumulative redd depth distribution included in the IFIM study conducted by USFWS (2003) indicate that the shallowest fall-run Chinook salmon redds were located in about 0.4 feet (about 5 inches) deep water. Therefore, change in stage associated with cessation of the Proposed Action Alternative transfer period would not expected to dewater any fall-run Chinook salmon redds.

During the adult fall-run Chinook salmon adult spawning and egg incubation period potentially affected by the Proposed Action Alternative relative to the No Action Alternative, river flow fluctuations or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to appreciably affect adult fall-run Chinook salmon spawning and egg incubation.

Adult Steelhead Spawning and Egg Incubation In the lower American River, steelhead spawning generally extends from late-December to April. Therefore, steelhead spawning and egg incubation does not have the potential to be affected under the Proposed Action Alternative relative to the No Action Alternative.

Juvenile Fall-run Chinook Salmon and Steelhead Rearing and Emigration The juvenile fall-run Chinook salmon rearing and emigration period extends from late-December into June. Therefore, juvenile fall-run Chinook salmon rearing and emigration do not have the potential to be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

The primary period of steelhead smolt emigration occurs from March through June (Castleberry et al. 1991). It has been reported that steelhead move downstream as young-of-the-year (YOY) in the lower American River (Snider and Titus 2000b) from late-spring through summer. Nonetheless, some juvenile steelhead rearing is believed to occur year-round in the lower American River.

The increased flow rates associated with the Proposed Action Alternative from November 10 to December 15, 2008 relative to the No Action Alternative in the lower American River below Nimbus Dam would not be expected to increase the amount of habitat available for juvenile steelhead rearing. From mid-November to mid-December, it is expected that water temperatures in the lower American River would not change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative.

At the end of the Proposed Action Alternative water transfer period on December 15, 2008, flows would be reduced from 1,100 to 1,000 cfs which would correspond to a stage reduction of about 1.5 to 2 inches. This change in stage would not be expected to result in juvenile stranding, particularly because steelhead present during this time of year would be expected to be larger individuals with increased swimming capability.

During the juvenile steelhead rearing period potentially affected by the Proposed Action Alternative relative to the No Action Alternative, river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to affect juvenile steelhead rearing.

American Shad American shad immigration generally occurs from April through June, with corresponding spawning and egg incubation occurring from mid-May through June. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not appreciably change during this time period, American shad would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Striped Bass Striped bass spawning, embryo incubation, and initial rearing period may begin in April, but generally peaks in May and early-June. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not notably change during this time period, striped bass spawning, embryo incubation, and initial rearing period would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative. In the lower American River, sub adult and adult striped bass have been observed opportunistically foraging during other months of the year. However, because flows under the Proposed Action Alternative relative to the No Action Alternative would not appreciably change throughout the year, striped bass would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento Splittail Sacramento splittail spawning, egg incubation, and initial rearing can occur between late February and early July, but peak spawning occurs in March and April. Because flows under the Proposed Action Alternative relative to the No Action Alternative would not notably change during this time period, Sacramento splittail spawning, embryo incubation, and initial rearing would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

Other Fish Species The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Proposed Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be appreciably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to appreciably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the lower American River also would not be appreciably affected under the Proposed Action Alternative relative to the No Action Alternative.

Folsom Reservoir

Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 12,859 AF during November through December 2008. End of December 2008 storage in Folsom Reservoir is expected to be 239,000 AF under the No Action Alternative, and 251,859 AF under the Proposed Action Alternative.

Coldwater Fisheries The anticipated increase in reservoir storage would not be expected to notably affect Folsom Reservoir's coldwater fisheries because: (1) coldwater habitat would remain at the same or slightly higher levels within the reservoir during all months of the April to November period; (2) physical habitat availability is not believed to be among the primary factors limiting coldwater fish populations; and (3) anticipated seasonal changes in storage would not be expected to notably affect the primary prey species utilized by coldwater fishes. Therefore, changes in end-of-month storage under the Proposed Action Alternative relative to the No Action Alternative would not result in notable effects to coldwater fish resources in Folsom Reservoir.

Warmwater Fisheries Folsom Reservoir's warmwater fish species (e.g., bass, sunfish, crappie, and catfish) utilize the warm upper layer of the reservoir and nearshore littoral habitats throughout much of the year. Changes in reservoir storage, as it affects reservoir water surface elevation can affect the reservoir's warmwater fisheries resources. Reduced water surface elevations can reduce the availability of nearshore littoral habitats used by warmwater fishes for spawning and rearing. Under the Proposed Action Alternative, storage is expected to increase by 12,859 AF by mid-December 2008, relative to the No Action Alternative, increasing nearshore littoral habitat for spawning and rearing warmwater fish. Therefore, the increase in storage in Folsom Reservoir would not be expected to appreciably affect the warmwater fisheries in Folsom Reservoir.

Sacramento River

Flows on the lower Sacramento River (below the confluence with the lower American River) would not change under the Proposed Action Alternative, relative to the No Action Alternative. Because there is no change in flow, fish and aquatic resources in the lower Sacramento River below the confluence with the lower American River would not be affected.

The total transfer release under the Proposed Action Alternative would be approximately 100 cfs lower from November 10 through December 15, 2008 than flows expected under the No Action Alternative on the Sacramento River from Keswick Dam to the confluence with the lower American River. Following is an assessment of potential effects to fish and aquatic resources in the Sacramento River from Keswick Dam to the confluence with the lower American River.

Winter-run Chinook Salmon Adult winter-run Chinook salmon immigration and holding in the Sacramento River occurs from December through July, with a peak during the period extending from January through April. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon adult immigration and holding under the Proposed Action Alternative relative to the No Action Alternative.

Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243) between late-April and mid-August, with a peak generally in June. Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October. Therefore, winter-run Chinook salmon spawning and incubation would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Winter-run Chinook salmon fry rearing and emigration in the upper Sacramento River can extend from June through April. Emigration of winter-run Chinook salmon juveniles past Knights Landing, approximately 155.5 river miles downstream of the Red Bluff Diversion Dam, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon juvenile rearing and emigration. In addition, the slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding.

Spring-run Chinook Salmon Adult spring-run Chinook salmon immigration and holding occurs from mid-February through September, and therefore would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Spawning has been reported to occur from September through December, with spawning peaking in mid-September. Embryo incubation generally occurs from September through March. Examination of the spawning habitat- flow relationships developed (USFWS 2003) for Chinook salmon in the Sacramento River indicate that a change in flow from 4,875 to 4,775 cfs from November 10 through November 30, 2008, and from 4,079 to 3,979 cfs during the first half of December 2008 would not noticeably reduce spawning habitat availability under the Proposed Action Alternative relative to the No Action Alternative. Additionally, this slight decrease in flow during this time period would not result in an appreciable change in water temperature, and therefore would not affect spawning habitat suitability.

At the end of the Proposed Action Alternative water transfer period on December 15, 2008, flows would return to 4,079 cfs which would not result in an appreciable change in stage and therefore would not be expected to result in redd dewatering. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect spring-run Chinook salmon embryo incubation.

Once incubation is completed and fry emerge from the redds, some portion of an annual year-class may emigrate as post-emergent fry, and some rear in the upper Sacramento River and tributaries during the winter and spring and emigrate as juveniles. The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period extending from October through April. The slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of spring-run Chinook salmon juvenile rearing and emigration.

Under the Proposed Action Alternative, critical habitat for the spring-run Chinook salmon in the Sacramento River would not be affected relative to the No Action Alternative.

Fall-run Chinook Salmon Adult fall-run Chinook salmon generally begin migrating upstream annually as early as June, with immigration continuing through December in most years. Adult fall-run Chinook salmon immigration generally peaks in November, and typically greater than 90 percent of the run has entered the river by the end of November. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to appreciably affect the physical habitat availability or water temperature suitability of fall-run Chinook salmon adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Fall-run Chinook salmon spawning period generally extends from October through December. Embryo incubation generally occurs from October through March. Examination of the spawning habitat- flow relationships developed (USFWS 2003) for Chinook salmon in the Sacramento River indicate that this slight decrease in flow would not noticeably reduce spawning habitat availability under the Proposed Action Alternative relative to the No Action Alternative. Additionally, this slight decrease in flow during this time period would not result in an appreciable change in water temperature, and therefore would not affect spawning habitat suitability. Flows at the end of the Proposed Action Alternative water transfer period would return to 4,079 cfs, which would not result in an appreciable change in stage and therefore would not be expected to result in redd dewatering. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect fall-run Chinook salmon embryo incubation.

Fall-run Chinook salmon fry emergence generally occurs from late-December through March, and juvenile rearing and emigration occurs from January through June and, therefore, would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Late Fall-Fun Chinook Salmon Late fall-run Chinook salmon immigration in the Sacramento River occurs from October through April, with a peak during December. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of late fall-run Chinook salmon adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Late fall-run Chinook salmon spawn in the Sacramento River from early January to March, with embryonic incubation extending from January to June. Therefore, late fall-run Chinook salmon spawning and incubation would not be affected by the Proposed Action Alternative relative to the No Action Alternative.

Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the April through December period. Juvenile rearing can extend from seven to thirteen months in the Sacramento River subsequent to emergence. The slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of late fall-run Chinook salmon juvenile rearing and emigration.

Steelhead Adult steelhead immigration generally can extend from August into March, with peak immigration during January and February. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of steelhead adult immigration under the Proposed Action Alternative relative to the No Action Alternative.

Spawning usually begins during late-December and may extend through March, but also can range from November through April. Embryo incubation can generally extend from November to May.

Examination of the spawning habitat- flow relationships developed (USFWS 2003) for steelhead in the Sacramento River indicate that the slight decrease in flow would not noticeably reduce spawning habitat availability or result in an appreciable change in water temperature and, therefore, would not affect spawning habitat suitability under the Proposed Action Alternative relative to the No Action Alternative. An appreciable change in stage at the end of the Proposed Action Alternative water transfer period would not occur, and therefore would not be expected to result in redd dewatering. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect steelhead embryo incubation.

Juvenile steelhead rearing can extend year-round in the Sacramento River, and the primary period of steelhead smolt emigration occurs from March through June. Thus, smolt emigration would not be expected to be affected by implementation of the Proposed Action Alternative relative to the No Action Alternative. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of steelhead juvenile rearing.

Under the Proposed Action Alternative, critical habitat for the Central Valley steelhead in the Sacramento River would not be affected relative to the No Action Alternative.

Green Sturgeon Green sturgeon generally begin their inland migration in late-February, and enter the Sacramento River between February and late-July. Spawning activities occur from March through July, with peak activity believed to occur between April and June. The green sturgeon immigration and spawning periods do not include the period of the Proposed Action Alternative. Therefore, no changes to green sturgeon immigration and spawning are expected to occur in the Sacramento River under the Proposed Action Alternative relative to the No Action Alternative.

Juvenile green sturgeon reportedly rear in their natal streams year-round. The decreased flow rates associated with the Proposed Action Alternative from November 10 to December 15, 2008 relative to the No Action Alternative in the Sacramento River would not be expected to reduce the amount of habitat available for juvenile green sturgeon rearing. From mid-November to mid-December, it is expected that water temperatures in the Sacramento River would not change with the implementation of the Proposed Action Alternative, relative to the No Action Alternative. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to affect the physical habitat availability or water temperature suitability of green sturgeon juvenile rearing.

American Shad American shad immigration and spawning generally occurs from mid-May through June, which is outside the Proposed Action Alternative period. Therefore, American shad immigration and spawning are not expected to change under the Proposed Action Alternative relative to the No Action Alternative.

Striped Bass Striped bass spawning, embryo incubation, and initial rearing in the Sacramento River would not be affected by the Proposed Action Alternative relative to the No Action Alternative, because flows during the period of these lifestages would not change under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento Splittail Sacramento splittail spawning, egg incubation, and initial rearing can occur between late February and early July, with peak spawning occurs in March and April. Therefore, Sacramento splittail do not have the potential to be affected under the Proposed Action Alternative relative to the No Action Alternative.

Other Fish Species The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Proposed Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be appreciably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the Sacramento River to notably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the Sacramento River also would not be notably affected under the Proposed Action Alternative relative to the No Action Alternative.

Shasta Reservoir

Shasta Reservoir storage is expected to increase by approximately 7,141 AF by the end of December 2008. The projected minor storage and associated water surface elevation changes are not expected to affect the coldwater and warmwater fisheries of Shasta Reservoir under the Proposed Action Alternative relative to the No Action Alternative.

Sacramento-San Joaquin Delta

Evaluation parameters selected for part of this evaluation of the Proposed Action Alternative relative to the No Action Alternative includes examination of the habitat parameters of X2 location, Delta outflow, E/I ratio, and fish salvage at south Delta export facilities.

Under the Proposed Action Alternative relative to the No Action Alternative, neither Delta inflows nor export pumping from the Jones and Banks pumping plants would change during November 10 through December 15, 2008, because flows below the confluence of the lower American River and Sacramento River would not change. Subsequent to December 15, 2008, changes in flows in the lower American and Sacramento rivers, or export pumping, over the course of 2009 would be de minimus (or non-observable) due to the very small incremental alterations in CVP operations associated with the Proposed Action Alternative. Therefore, implementation of the Proposed Action Alternative relative to the No Action Alternative is expected to result in de minimus (or non-observable) changes to X2 location, Delta outflow, E/I ratio, or fish salvage at south Delta export facilities. Hence, potential changes in the habitat parameters of X2 location, Delta outflow, and E/I ratio, and salvage (or loss) would not be of sufficient magnitude or duration to adversely affect anadromous salmonids, green sturgeon, delta smelt, or other fish species in the Delta.

San Luis Reservoir

Under the Proposed Action Alternative, San Luis Reservoir storage would not change relative to the No Action Alternative. Therefore, the coldwater and warmwater fisheries of San Luis Reservoir would not be affected by implementation of the Proposed Action Alternative relative to the No Action Alternative.

4.6.5 Summer 2009 Action Alternative

Middle Fork and North Fork American Rivers

Potential changes in flow and water temperature in the Middle Fork and North Fork American Rivers under the Summer 2009 Action Alternative are identical to those under the Proposed Action Alternative (see section 4.6.4). Therefore, changes in flow and water temperature during November and December 2008 associated with the action alternatives relative to the No Action Alternative would not result in notable effects to fisheries and aquatic resources in Middle Fork and North Fork American rivers.

Hell Hole Reservoir Potential changes in storage and associated water surface elevations in Hell Hole Reservoir under the Summer 2009 Action Alternative are identical to those under the Proposed Action Alternative (see section 4.6.4). Therefore, changes in end-of-month storage and water surface elevation under the Summer 2009 Action Alternative relative to the No Action Alternative would not result in notable effects to the coldwater or warmwater fish resources in Hell Hole Reservoir.

Lower American River

Under the Summer 2009 Action Alternative, the transfer water would be released from Folsom Reservoir during July and August of 2009. Flows in the lower American River below Nimbus Dam would remain the same as the No Action Alternative except for these two months. Consequently, flows would be approximately 163 cfs higher during July and August of 2009 than flows expected under the No Action Alternative in the lower American River below Nimbus Dam.

Fall-run Chinook Salmon Because flows in the lower American River below Nimbus Dam would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only fall-run Chinook salmon lifestage potentially affected is adult upstream immigration. According to Reclamation's operational forecast flows in the lower American River below Nimbus Dam are expected to be 3,690 and 2,772 cfs during July and August under the No Action Alternative, and 3,753 and 2,935 cfs under the Summer 2009 Action Alternative.

Adult upstream immigration of fall-run Chinook salmon generally occurs from August through December. The increased flow rates associated with the Summer 2009 Action Alternative relative to the No Action Alternative in the lower American River below Nimbus Dam during August 2009 have the potential to facilitate the upstream migration of adult fall-run Chinook salmon, would not be expected to reduce the attraction of adults immigrating into the lower American River, nor be of sufficient magnitude to encourage additional straying into the lower American River.

The release water temperatures from Nimbus Dam are associated with operation of the water temperature shutter control device at Folsom Dam. Implementation of the Summer 2009 Action Alternative relative to the No Action Alternative has some potential to increase the operational flexibility and management of the coldwater pool in Folsom Reservoir during spring and summer 2009. However, it is expected that water temperatures in the lower American River would not notably change with the implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative.

During the adult fall-run Chinook salmon adult immigration period potentially affected by the Summer 2009 Action Alternative relative to the No Action Alternative, changes in river flow or water temperatures of sufficient magnitude or duration would not occur in the lower American River to appreciably affect adult immigration.

Steelhead Because flows in the lower American River below Nimbus Dam would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only steelhead lifestage potentially affected is juvenile rearing.

The increased flow rates associated with the Summer 2009 Action Alternative during July and August 2009 relative to the No Action Alternative in the lower American River below Nimbus Dam would not be expected to notably increase the physical habitat availability or water temperature suitability for juvenile steelhead rearing. At the end of August 2009, flows would be reduced by 163 cfs under the Summer 2009 Action Alternative relative to the No Action Alternative, which would correspond to a stage reduction of about 1.5 to 2 inches. This change in stage would not be expected to result in appreciable amounts of juvenile stranding, particularly because steelhead present during this time of year would be expected to be larger individuals with increased swimming capability. During the juvenile steelhead rearing period potentially affected by the Summer 2009 Action Alternative relative to the No Action Alternative, changes in river flows and water temperatures would not be of sufficient magnitude or duration in the lower American River to notably affect juvenile steelhead rearing.

American Shad, Striped Bass, Sacramento Splittail Because flows in the lower American River below Nimbus Dam would remain the same under the Summer 2009 Action

Alternative relative to the No Action Alternative except for July and August 2009, the only lifestages potentially affected include striped bass sub-adult and adult foraging. Because flows and water temperatures under the Summer 2009 Action Alternative relative to the No Action Alternative would not notably change throughout the year, striped bass would not be appreciably affected under the Summer 2009 Action relative to the No Action Alternative.

Other Fish Species The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Summer 2009 Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be appreciably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower American River to appreciably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the lower American River also would not be notably affected under the Summer 2009 Action Alternative relative to the No Action Alternative.

Folsom Reservoir Under the Summer 2009 Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 20,000 AF during November through December 2008. This additional storage would be released from Folsom Reservoir during July and August 2009. By the end of August 2009, storage in Folsom Reservoir is expected to be equivalent to the No Action Alternative.

Coldwater Fisheries The anticipated increase in reservoir storage would not be expected to notably affect Folsom Reservoir's coldwater fisheries because: (1) coldwater habitat would remain at the same or slightly higher levels within the reservoir from November 2008 through 2009; (2) physical habitat availability would not be substantively reduced; and (3) anticipated seasonal changes in storage would not be expected to notably affect the primary prey species utilized by coldwater fishes. Therefore, changes in storage under the Summer 2009 Action Alternative relative to the No Action Alternative would not result in notable effects to coldwater fish resources in Folsom Reservoir.

Warmwater Fisheries Folsom Reservoir's warmwater fish species (e.g., bass, sunfish, crappie, and catfish) utilize the warm upper layer of the reservoir and nearshore littoral habitats throughout much of the year. No additional decreases in month-to-month reservoir water surface elevations of more than six feet per month, under the Summer 2009 Action Alternative relative to the No Action Alternative, would occur during the warmwater fish March through June spawning period. Under the Summer 2009 Action Alternative, increases in storage and associated water surface elevations would not be expected to appreciably increase warmwater fish rearing habitat. Therefore, the increase in storage in Folsom Reservoir potentially occurring from November 2008 through August 2009, and equivalent storage thereafter, would not be expected to notably affect the warmwater fisheries in Folsom Reservoir.

Sacramento River

Flows in the upper Sacramento River (above the confluence with the lower American River) would not change under the Summer 2009 Action Alternative, relative to the No Action Alternative. Because there is no change in flow, fish and aquatic resources in the upper

Sacramento River above the confluence with the lower American River would not be affected. In addition, storage and water surface elevation in Shasta Reservoir would not change under the Summer 2009 Action Alternative, relative to the No Action Alternative, and the coldwater and warmwater fisheries in Shasta Reservoir would not be affected.

Under the Summer 2009 Action Alternative, the transfer water would be released from Folsom Reservoir during July and August of 2009. Flows in the lower Sacramento River below the confluence with the lower American River would remain the same as the No Action Alternative except for these two months. Consequently, flows would be approximately 163 cfs higher during July and August of 2009 than flows expected under the No Action Alternative in the lower Sacramento River. The lower Sacramento River primarily serves as a migratory corridor to and from upstream spawning areas; although the lower Sacramento River can be used a transient rearing area associated with juvenile emigration of various fish species.

Winter-run Chinook Salmon Adult winter-run Chinook salmon immigration and holding in the Sacramento River occurs from December through July, with a peak during the period extending from January through April. Relatively minor potential changes in flow or water temperature in the lower Sacramento River would not be of sufficient magnitude or duration to appreciably affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon adult immigration and holding under the Summer 2009 Action Alternative relative to the No Action Alternative.

Winter-run Chinook salmon fry rearing and emigration in the upper Sacramento River can extend from June through April, although emigration of winter-run Chinook salmon juveniles past Knights Landing, approximately 155.5 river miles downstream of the Red Bluff Diversion Dam, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years. Therefore, few if any juvenile winter-run Chinook salmon would be expected to be present in the lower Sacramento River during July and August. Nonetheless, relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to appreciably affect the physical habitat availability or water temperature suitability of winter-run Chinook salmon juvenile rearing and emigration. In addition, the slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding under the Summer 2009 Action Alternative relative to the No Action Alternative.

Spring-run Chinook Salmon Because flows in the lower Sacramento River would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only spring-run Chinook salmon lifestage potentially affected is adult upstream immigration. Adult spring-run Chinook salmon immigration and holding occurs from mid-February through September. It is expected that water temperatures during August 2009 in the lower Sacramento River would not appreciably (or perhaps even measurably) change with the implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative. Therefore, changes in river flow or water temperatures of sufficient magnitude or duration would not occur in the lower Sacramento River to appreciably affect spring-run Chinook salmon adult immigration.

Under the Summer 2009 Action Alternative, critical habitat for the spring-run Chinook salmon in the Sacramento River would not be affected relative to the No Action Alternative.

Fall-Run Chinook Salmon Because flows in the lower Sacramento River would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only fall-run Chinook salmon lifestage potentially affected is adult upstream immigration.

Adult upstream immigration of fall-run Chinook salmon generally occurs from August through December. It is expected that water temperatures during August 2009 in the lower Sacramento River would not measurably change with the implementation of the Summer 2009 Action Alternative, relative to the No Action Alternative. Therefore, changes in river flow or water temperatures of sufficient magnitude or duration would not occur in the lower Sacramento River to notably affect fall-run Chinook salmon adult immigration.

Late Fall-Run Chinook Salmon Because flows in the lower Sacramento River would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only late fall-run Chinook salmon lifestage potentially affected is juvenile rearing and emigration.

Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the April through December period into lower Sacramento River. The slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to notably affect the physical habitat availability or water temperature suitability of late fall-run Chinook salmon juvenile rearing and emigration.

Steelhead Because flows in the lower Sacramento River would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only steelhead lifestages potentially affected are adult immigration and juvenile rearing and emigration.

Adult steelhead immigration generally can extend from August into March, with peak immigration during January and February. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to appreciably affect the physical habitat availability or water temperature suitability of steelhead adult immigration under the Summer 2009 Action Alternative relative to the No Action Alternative.

Juvenile steelhead rearing can extend year-round in the Sacramento River, and the primary period of steelhead smolt emigration occurs from March through June. Thus, smolt emigration would not be expected to be affected by implementation of the Summer 2009 Action Alternative relative to the No Action Alternative. Few if any juvenile steelhead would be expected to be present in the lower Sacramento River during July and August. Nonetheless, relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to appreciably affect the physical habitat availability or water temperature suitability of steelhead juvenile rearing and emigration. In addition, the slight decrease in flow at the cessation of the water transfer would not result in an appreciable change in stage, and would not be expected to result in juvenile stranding under the Summer 2009 Action Alternative relative to the No Action Alternative.

Under the Summer 2009 Action Alternative, critical habitat for the Central Valley steelhead in the Sacramento River would not be affected relative to the No Action Alternative.

Green Sturgeon Green sturgeon generally begin their inland migration in late-February, and enter the Sacramento River between February and late-July. Juvenile green sturgeon reportedly rear in their natal streams year-round. Relatively minor potential changes in flow or water temperature would not be of sufficient magnitude or duration to notably affect the physical habitat availability or water temperature suitability of green sturgeon adult immigration or juvenile rearing under the Summer 2009 Action Alternative relative to the No Action Alternative.

American Shad, Striped Bass, Sacramento Splittail Because flows in the lower Sacramento River would remain the same under the Summer 2009 Action Alternative relative to the No Action Alternative except for July and August 2009, the only lifestages potentially affected include striped bass sub-adult and adult foraging. Because flows and water temperatures under the Summer 2009 Action Alternative relative to the No Action Alternative would not notably change throughout the year, striped bass would not be notably affected under the Summer 2009 Action Alternative relative to the No Action Alternative.

Other Fish Species The life history requirements of anadromous salmonids are generally more restrictive than those of other fish species found in the river. Thus, if anadromous salmonids are not notably affected by the Summer 2009 Action Alternative relative to the No Action Alternative, it is unlikely that other, less sensitive fish species would be notably affected. Because river flow decreases or water temperature increases of sufficient magnitude or duration would not occur in the lower Sacramento River to appreciably affect anadromous salmonids, as well as American shad, striped bass and Sacramento splittail, other fish species in the lower Sacramento River also would not be appreciably affected under the Summer 2009 Action Alternative relative to the No Action Alternative.

Shasta Reservoir

Under the Summer 2009 Action Alternative, Shasta Reservoir storage and associated water surface elevation would not change relative to the No Action Alternative. Therefore, the coldwater and warmwater fisheries of Shasta Reservoir would not be affected by implementation of the Summer 2009 Action Alternative relative to the No Action Alternative.

Sacramento-San Joaquin Delta

Evaluation parameters selected for part of this evaluation of the Summer 2009 Action Alternative relative to the No Action Alternative includes examination of the habitat parameters of X2 location, Delta outflow, E/I ratio, and fish salvage at south Delta export facilities.

Under the Summer 2009 Action Alternative relative to the No Action Alternative, neither Delta inflows nor export pumping from the Jones and Banks pumping plants would change during November 10 through December 15, 2008. Flows below the confluence of the lower American River and Sacramento River would not change. During July and August 2009, Delta inflows would increase 163 cfs, but because of carriage water considerations, export pumping would increase only 130 to 146 cfs under the Summer 2009 Action Alternative, relative to the No Action Alternative.

Implementation of the Summer 2009 Action Alternative relative to the No Action Alternative would not result in changes to X2 location, but would result in slight increases in Delta outflow (1 percent). E/I ratios would be expected to increase less than 1 percent (to 46 and 52 percent during the months of July and August 2009, respectively), but remain well below the current Bay-Delta Water Quality Control Plan E/I ratio requirements of 65 percent for July and August. Hence, potential changes in the habitat parameters of X2 location, Delta outflow, and E/I ratio would not be of sufficient magnitude or duration to adversely affect anadromous salmonids, green sturgeon, delta smelt, or other fish species in the Delta.

Combined CVP and SWP pumping at Banks and Jones pumping plants under the No Action Alternative is presently anticipated to be at a rate of 6,538 cfs during July, and 5,871 cfs during August 2009. Under the Summer 2009 Action Alternative, anticipated combined CVP and SWP pumping at both facilities is expected to be at rates ranging from 6,668 to 6,684 cfs during July, and 6,001 to 6,017 cfs during August 2009.

The August 2008 OCAP BA assesses potential salvage and loss of several fish species associated with export pumping at the Jones and Banks pumping plants, by month and water year type. According to the August 2008 OCAP BA, juvenile salmonids are rarely present in the Delta during July and August. Based on the tabular data represented in the August 2008 OCAP BA, changes in exports do not result in changes in salvage or loss for the months of July and August because of the lack of presence of juvenile salmonids during this period. The percent changes in export pumping between model studies presented in the OCAP BA are larger than those expected for the Summer 2009 Action Alternative relative to the No Action Alternative. Hence, implementation of the Summer 2009 Action Alternative relative to the No Action Alternative is not expected to result in an increase in salvage and loss of juvenile salmonids. In fact, the August 2008 OCAP BA suggests that water transfers could be beneficial if they shift the time of year that water is pumped from the Delta from the winter and spring period to the summer, avoiding periods of higher salmonid abundance in the vicinity of the pumps.

Export pumping is of particular concern during dry years, when the distributions of young striped bass, delta smelt, and longfin smelt shift upstream, closer to the export pumping facilities. Adult delta smelt have the greatest potential to be affected by export operations during their upstream spawning migration between December and April and, therefore, would not be expected to be affected by the Summer 2009 Action Alternative relative to the No Action Alternative. Most delta smelt juvenile salvage can occur from April to July, with a peak in May and June. Delta smelt salvage is generally very near zero from July through November (IEP unpublished data as cited in Reclamation 2008).

Implementation of the Summer 2009 Action Alternative relative to the No Action Alternative is not expected to result in an increase in salvage of delta smelt (and presumably longfin smelt, striped bass, and other Delta fishes) because of near zero salvage during July and August, and because of the small incremental change (about 2 percent) in export pumping.

Examination of the data presented on page 8-18 of the August 2008 OCAP BA indicates that for the period 1968-2001 (DFG 2002 as cited in Reclamation 2008) the highest monthly salvage of juvenile green sturgeon at the export facilities occurs during the month of August, followed by July. Under the Summer 2009 Action Alternative relative to the No Action Alternative, Delta export pumping would increase approximately 2 percent during July and August 2009. If green sturgeon salvage is proportionally related to export pumping, then it could be also assumed that green sturgeon salvage could increase by approximately 2 percent. Further examination of the data presented on page 8-21 of the August 2008 OCAP BA indicates that since 1986, little or no green sturgeon salvage was observed at the export fish salvage facilities. Therefore, it may be logical to conclude that increased export pumping during July and August 2009 associated with the Summer 2009 Action Alternative may not increase salvage at the export fish salvage facilities. However, based on information available at the time of the preparation of the Draft EA, it is possible that green sturgeon salvage could increase during July and August under the Summer 2009 Action Alternative relative to the No Action Alternative.

San Luis Reservoir

Under the Summer 2009 Action Alternative, storage in San Luis Reservoir could slightly and temporarily increase during July and August 2009 relative to the No Action Alternative. Therefore, no reductions in storage (or associated water surface elevation) would occur under the Summer 2009 relative to the No Action Alternative, and the coldwater and warmwater fisheries of San Luis Reservoir would not be affected.

4.7 Terrestrial and Riparian Resources

Riparian systems provide habitat that is used by numerous species, including special status-species and species of federal, state, and local concern. Existing riparian forest and other backwater communities within the Action Area could be affected by changes in hydrologic conditions (e.g., instream flows and reservoir storage). The analysis of potential effects on terrestrial and riparian resources associated with implementation of the Proposed Action or the Spring 2009 Action Alternatives was based on the following:

- Increase or decrease in instream flow, of sufficient magnitude and duration, to adversely affect the growth, maintenance, and reproductive capability of riparian vegetation; and
- Increase or decrease in reservoir water surface elevation, of sufficient magnitude and duration to decrease and degrade continuous stands of native vegetation of relatively high to moderate wildlife value, relative to the No Action Alternative.

4.7.1 Proposed Action

Middle Fork and North Fork American Rivers

Although the Proposed Action Alternative would transfer water from Hell Hole Reservoir on the Rubicon River, the upstream reach of the Rubicon River between Hell Hole Reservoir and Ralston Afterbay would not change because the water transfer would occur via an enclosed delivery conduit. The upstream river reaches of both the Middle Fork American River and Rubicon River would not be subject to changes in flow, relative to the No Action Alternative, as a result of the proposed water transfer. Therefore, no change to riparian or terrestrial vegetation or associated wildlife would occur in the upstream reaches of the Middle Fork and North Fork American rivers, and the Rubicon River relative to the No Action Alternative.

Below Oxbow Powerhouse on the Middle Fork American River, the proposed use of the transfer water is to provide additional on-peak generation under the Proposed Action Alternative. The minimum and maximum flow rates for the day would remain the same as under the No Action Alternative; only the duration of the maximum flow would increase for up to ten hours per day during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow. Hence, under the Proposed Action Alternative, the daily flow changes would not be sufficient to affect the growth, maintenance, and reproductive capability of the riparian or terrestrial vegetation or associated wildlife along the Middle Fork and North Fork American rivers.

Hell Hole Reservoir Under the Proposed Action Alternative, water storage in Hell Hole Reservoir would be reduced by 20,000 AF between November and December 2008, relative to the No Action Alternative. This decrease in water storage is expected to be within the historic storage range. Because the drawdown zone of this reservoir is essentially devoid of vegetation, it does not provide valuable plant communities or wildlife habitats. Therefore, the proposed change in the reservoir water surface elevation would not affect the terrestrial and riparian resources at Hell Hole Reservoir, relative to the No Action Alternative.

Lower American River

Under the Proposed Action Alternative, flows within the lower American River would increase by 100 cfs between November and December 2008, relative to the No Action Alternative. Under the Summer 2009 Action Alternative, flows within the Lower American River would increase by 163 cfs during July and August 2009, relative to the No Action Alternative. This slight increase in flow would not be sufficient magnitude or duration to affect riparian and terrestrial resources along the lower American River, relative to the No Action Alternative.

Folsom Reservoir Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 12,859 AF by the end of December 2008. End of December 2008 storage in Folsom Reservoir is expected to be 239,000 AF under the No Action Alternative, and 251,859 AF under the Proposed Action Alternative. Because no decreases in reservoir storage would occur under Proposed Action Alternative, terrestrial and riparian resources would not be affected.

Sacramento River

Under the Proposed Action Alternative, flows in the Sacramento River below Keswick Dam to the confluence with the lower American River, would decrease by 100 cfs from November 10 through December 15, 2008, relative to the No Action Alternative. The decrease in water flows in the Sacramento River below Keswick Dam would not be of a sufficient magnitude or duration to affect terrestrial and riparian resources along the Sacramento River below Keswick Dam.

Shasta Reservoir Under the Proposed Action Alternative, Shasta Reservoir storage would increase relative to the No Action Alternative by up to 7,141 AF by the end of December 2008. This increase in water storage is expected to fluctuate the water level within the normal drawdown zone of Shasta Reservoir. Since the drawdown zone of this reservoir is essentially devoid of vegetation and does not provide valuable plant communities or wildlife habitats, the proposed change in the reservoir water surface elevation would not affect terrestrial and riparian resources at Shasta Reservoir, relative to the No Action Alternative.

Sacramento-San Joaquin Delta

Under the Proposed Action Alternative, water flows would not change relative to the No Action Alternative. Under the Summer 2009 Action Alternative, flows within the Delta would increase by 163 cfs during July and August 2009, relative to the No Action Alternative. Under the Proposed Action Alternative, there would be no decrease in flows and the increase in flows would not be sufficient magnitude or duration to affect terrestrial and riparian resources along the Delta.

San Luis Reservoir

Under the Proposed Action Alternative, water storage within the San Luis Reservoir is not expected to change relative to the No Action Alternative. Under the Summer 2009 Action Alternative, water storage within San Luis Reservoir may increase slightly during July and August 2009, relative to the No Action Alternative. This increase in water storage is expected to cause a minor fluctuation in the water level within the drawdown zone of San Luis Reservoir. Since the drawdown zone of this reservoir is essentially devoid of vegetation and does not provide valuable plant communities or wildlife habitats and the change would not be of a sufficient magnitude or duration, the proposed change in the reservoir water surface elevation is not expected to affect vegetation and associated wildlife at San Luis Reservoir.

4.7.2 Summer 2009 Action Alternative

Terrestrial and riparian resources for the Action Area rivers and reservoirs would have the same effects under the Summer 2009 Action Alternative as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.8 Recreation

4.8.1 Proposed Action

Recreational opportunities (i.e., wildlife viewing, fishing, waterfowl hunting, swimming, motor boating, rafting, sailing, and windsurfing) associated with waterbodies within the Action Area could be affected by changes in reservoir levels and river flows with implementation of the Proposed Action Alternative relative to the No Action Alternative. The analysis of potential affects on recreation opportunities associated with implementation of the Proposed Action Alternative within the Action Area was based on potential changes in reservoir levels and river flows of sufficient magnitude and duration to affect recreational opportunities, relative to the No Action Alternative.

Middle Fork and North Fork American Rivers

Although the Proposed Action Alternative would transfer water from Hell Hole Reservoir on the Rubicon River, the upstream reach of the Rubicon River between Hell Hole Reservoir and Ralston Afterbay would not change because the water transfer would occur via an enclosed delivery conduit. The upstream river reaches of both the Middle Fork American River and Rubicon River would not be subject to changes in flow, relative to the No Action Alternative, as a result of the proposed water transfer. Therefore, under the Proposed Action Alternative, recreational opportunities in the upstream reaches of both the Middle Fork American and Rubicon rivers would not change, relative to the No Action Alternative.

Below Oxbow Powerhouse on the Middle Fork American River, the transfer water would be used for agriculture. In order to transfer the water, additional on-peak generation would be needed under the Proposed Action Alternative. The minimum and maximum flow rates for the day would remain the same as under the No Action Alternative; only the duration of the maximum flow would increase for up to ten hours per day during the daily on-peak generation period. Flows in the North Fork American River below the confluence with the Middle Fork American River would be similarly affected, although to a lesser extent due to downstream attenuation of the temporal distribution of flow. Hence, under the Proposed Action Alternative, recreational opportunities in the Middle Fork American River below Oxbow Powerhouse and North Fork American River would not be affected, relative to the No Action Alternative.

Hell Hole Reservoir Peak recreation season at this reservoir is during the summer months when reservoir elevation is above 106,150 AF (4,540 feet above msl). Boat ramps are most commonly inoperable in the winter months, when use is minimal or the reservoirs are inaccessible due to snow. Because 2008 is a dry year, PCWA’s contractual obligations caused the reservoir to fall below the 106,150 AF threshold for small craft launching prior to the initiation of the Proposed Action Alternative.

Under the Proposed Action Alternative, storage at Hell Hole Reservoir would be reduced during the months of November and December 2008, relative to the No Action Alternative. Storage would decrease by up to 20,000 AF by the end of December 2008 based on information provided by PCWA. Under the No Action Alternative, end of December 2008 storage is expected to be approximately 104,100 AF, and 84,100 AF under the action alternatives. Examination of storage at Hell Hole Reservoir obtained from CDEC demonstrates that since 2000, end of December storage has ranged from 44,968 to 198,063 AF, and end of September storage has ranged from 37,600 to 150,900 AF. Therefore, under the Proposed Action Alternative, storage in Hell Hole Reservoir would remain well within historical ranges, and above FERC minimum specified storage levels. However, it is uncertain whether any storage differences would remain subsequent to the 2008/2009 snowmelt runoff period. Nonetheless, even if this minor reduction in storage were to carry over into the summer of 2009, it would not be expected to substantively reduce recreation opportunities.

Peak recreation season at this reservoir is during the summer months and because there would only be a minor reduction in storage, recreation opportunities at Hell Hole Reservoir would not be affected by the Proposed Action Alternative, relative to the No Action Alternative.

Lower American River

The total transfer release under the Proposed Action Alternative during November through December would be approximately 100 cfs higher than flows expected under the No Action Alternative on the lower American River below Nimbus Dam. This slight increase (less than 2 inches in river stage) would not be expected to affect recreational opportunities in the lower American River.

Folsom Reservoir Under the Proposed Action Alternative, Folsom Reservoir storage would increase relative to the No Action Alternative by up to 12,859 AF by the end of December 2008. End of December 2008 storage in Folsom Reservoir is expected to be 239,000 AF under the No Action Alternative, and 251,859 AF under the Proposed Action Alternative. Because no decreases in reservoir storage would occur under Proposed Action Alternative, recreation opportunities would not be changed.

Sacramento River

Under the Proposed Action Alternative, flows in the Sacramento River below Keswick Dam to the confluence with the lower American River, would decrease by 100 cfs from November 10 through December 15, 2008, relative to the No Action Alternative. This slight decrease would not be expected to diminish recreation opportunities (e.g., rafting, fishing, boating, etc.) under the Proposed Action Alternative relative to the No Action Alternative.

Shasta Reservoir Under the Proposed Action Alternative, Shasta Reservoir storage would increase relative to the No Action Alternative by up to 7,141 AF by the end of December 2008. Because Shasta Reservoir storage would increase under the Proposed Action Alternative, recreation opportunities would not be affected.

Sacramento-San Joaquin Delta

Under the Proposed Action Alternative, inflows to the Delta would not change relative to the No Action Alternative and are anticipated to remain within the range of normal flow ranges and fluctuations resulting from SWP and CVP operations. Therefore, recreation opportunities would not be affected.

San Luis Reservoir

Under the Proposed Action Alternative, San Luis Reservoir storage and water surface elevation would not change relative to the No Action Alternative. Therefore, recreation opportunities would not be affected.

4.8.2 Summer 2009 Action Alternative

Recreational opportunities for the Action Area's rivers and reservoirs would have the same effects under the Summer 2009 Action Alternative as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.9 Cultural Resources

4.9.1 Proposed Action

The Proposed Action Alternative would involve the redistribution of water through existing Federal facilities. There would be no modification of water conveyance facilities and no activities that would result in ground disturbance. This action is administrative in nature and has no potential to affect historic properties pursuant to the regulations at 36 CFR Part 800.3(a)(1). Because there is no potential to affect historic properties, no cultural resources would be affected as a result of implementing Proposed Action Alternative relative to the No Action Alternative.

4.9.2 Summer 2009 Action Alternative

Cultural resources under the Summer 2009 Action Alternative would have the same effects as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.10 Indian Trust Assets

4.10.1 Proposed Action

In order to refill MFP reservoirs, without injury to downstream vested water rights holders following the transfer, PWCA would enter into a refill agreement with Reclamation, similar to refill agreements that PWCA and Reclamation have entered into on other PWCA transfers.

The Proposed Action Alternative would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and redivert water. Land uses within the PCWA and WWD service areas would not change as a result of the transfer.

On October 15, 2008 Reclamation determined that the Proposed Action Alternative relative to the No Action Alternative would not affect ITAs. The nearest ITA to the Action Area is the Santa Rosa Rancheria, which is approximately six miles east of the Action Area.

4.10.2 Summer 2009 Action Alternative

ITAs under the Summer 2009 Action Alternative would have the same effects as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.11 Environmental Justice

4.11.1 Proposed Action

There would be no changes in agricultural communities or practices resulting from the short-term water transfer or the associated movement of the water from the MFP reservoirs down the rivers and through the Delta relative to the No Action Alternative. Implementation of the Proposed Action Alternative would not alter employment opportunities or housing availability. Therefore, the Proposed Action Alternative would not have any disproportionate effect on low-income or minority individuals relative to the No Action Alternative. However, the Proposed Action Alternative would have a beneficial effect because the low-income agricultural workers would benefit from the Proposed Action Alternative, because an increased water supply would keep land from being fallowed and would allow them employment.

4.11.2 Summer 2009 Action Alternative

Environmental Justice under the Summer 2009 Action Alternative would have the same effects as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.12 Socioeconomics

4.12.1 Proposed Action

The transfer of 20,000 acre feet of water to WWD and WWDD1 would provide some relief to the area in this dry year and would help sustain existing croplands in WWD and WWDD1. Businesses rely on these crops to maintain jobs. The Proposed Action would not induce population growth within WWD, nor would seasonal labor requirements change. Agriculturally dependent businesses would not be affected by the Proposed Action. No adverse effects to public health and safety would occur. The Proposed Action would not have highly controversial or uncertain environmental effects or involve unique or unknown environmental risks. The Proposed Action would continue to support the economic vitality in the region. WWD is responsible for managing water for the benefit of agriculture, since they exist to support growers within their districts. Maximizing the use of water transfers is beneficial to local economic conditions and agricultural employment. There would be a slight positive impact on localized socioeconomics due the support of sustained agricultural from the transferred water.

4.12.2 Summer 2009 Action Alternative

Socioeconomics under the Summer 2009 Action Alternative would have the same beneficial effects as those described under the Proposed Action Alternative relative to the No Action Alternative.

4.13 Land Use

4.13.1 Proposed Action

Without the Proposed Action Alternative, agricultural land use would be affected by a lack of water supply. The Proposed Action Alternative would provide an additional water supply to agricultural lands in WWD and WWDD1. Therefore, the Proposed Action Alternative relative to the No Action Alternative would be a beneficial effect.

4.13.2 Summer 2009 Action Alternative

Land Use under the Summer 2009 Action Alternative would have the same beneficial effects as those described under the Proposed Action Alternative relative to the No Action Alternative.

5.0 Other Impact Considerations

NEPA regulations require analysis of cumulative impacts. Reclamation's NEPA policies further require that, along with environmental review and assessment activities, consideration be given to short-term uses of the environment versus long-term productivity, irreversible and irretrievable commitment of resources, ITAs, and Environmental Justice. Chapter 4, Environmental Consequences, describes the potential environmental consequences of the action alternatives for specific resource categories and impact issues. This chapter addresses broader, indirect, and more qualitative impact issues associated with the above NEPA requirements. The purpose of this chapter is to describe and evaluate:

- Potential cumulative impacts of the action alternatives when added to other past, present, and reasonably foreseeable future projects;
- The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity;
- Irreversible and irretrievable commitments of resources associated with the project; and
- Consistency of the project with Reclamation's ITA (Department of Interior Secretarial Order 3175) and Environmental Justice (Executive Order 12898) policies.

5.1 Cumulative Impacts

Cumulative impacts are defined in Council on Environmental Quality Regulations (40 CFR 1508.7 and 1508.25) as follows:

"Cumulative impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

5.1.1 Water Supply and Hydrology

The action alternatives would allow WWD and WWDD1 to utilize the transferred PCWA non-CVP water for meeting crop demands within WWD and WWDD1 and to alleviate current and future drought conditions. The action alternatives would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and store water. Export pumping from the pumping plants would not change during periods critical to Delta fisheries. The action alternatives, when added to other past, present, and future actions would not result in additional diversions of water relative to the No Action Alternative. There would be no anticipated decreases in water supply changes to CVP and PCWA customers, and therefore, no contribution to cumulative effects. On the basis of a drought declaration by the State and the counties of Fresno and Kings, WWD and WWDD1 need additional water during the drought.

5.1.2 Water Quality

Water quality would not be degraded as a result of the action alternatives relative to the No Action Alternative. Water transferred under the action alternatives would not contribute to cumulative effects. Short-term flows and storage changes in the Action Area's rivers and reservoirs may actually provide slightly better water quality by increasing the dilution of contaminants or would provide no change at all.

5.1.3 Hydropower

Water transferred under the action alternatives would not contribute to cumulative hydropower impacts relative to the No Action Alternative. The water being pumped is non-CVP water and the associated pumping energy costs would be borne by WWD and WWDD1 using commercial energy provided by the existing power grid. As a consequence CVP Project Energy use would not increase.

5.1.4 Fisheries and Aquatic Resources

Because fisheries and aquatic resources would not be notably affected with implementation of the action alternatives, there would be no cumulative effects relative to the No Action Alternative. Ongoing projects that support fisheries in the Action Area have indicated that the action alternatives would not have additive effects.

5.1.5 Terrestrial and Riparian Resources

Because the action alternatives would not affect terrestrial and riparian resources, the action alternatives would not contribute to cumulative impacts on those resources.

5.1.6 Recreation

No recreational effects on the Action Area's rivers and reservoirs are anticipated as a result of the action alternatives relative to the No Action Alternative; therefore, there would be no cumulative effects.

5.1.7 Cultural Resources

The action alternatives when added to the previous transfer activities and reasonably foreseeable transfer activities would not contribute to cumulative effects to archeological or cultural resources relative to the No Action Alternative. Because the action alternatives and future conveyance projects do not modify existing water conveyance facilities and do not include activities that would result in ground disturbance, there would be no additional cumulative effects from the action alternatives.

5.1.8 Indian Trust Assets

The action alternatives when added with the previous transfer activities and reasonably foreseeable transfer activities would not contribute to cumulative effects to ITAs relative to the No Action alternative. The action alternatives would not involve construction or modification of any facilities. Only existing facilities would be utilized to divert and redivert water. Therefore, there would be no additional cumulative effects from the action alternatives.

5.1.9 Environmental Justice

The action alternatives would not have any impact on minority or low-income populations within the Action Area relative to the No Action alternative. Therefore, there would be no contribution to cumulative effects as a result of implementing the action alternatives. The action alternatives would have a beneficial effect because the low-income agricultural workers would benefit, because an increased water supply would keep land from being fallowed and would allow them employment.

5.1.10 Land Use

The action alternatives, when taken into consideration with other water transfer activities, would not have the potential to induce growth, nor would it result in the cultivation of native untilled land relative to the No Action alternative.

5.1.11 Socioeconomics

The action alternatives would provide some drought relief to WWD and WWDD1 and would help sustain existing croplands. The action alternatives would have a beneficial effect because the low-income agricultural workers would benefit, because an increased water supply would keep land from being fallowed and would allow them employment. Therefore, there would be no contribution to cumulative effects as a result of implementing the action alternatives.

5.2 Relationship Between Short-Term Uses and Long-Term Productivity

Reclamation's NEPA policies require that during preparation of an EA, both short- and long-term impacts should be addressed (Section 102(2)(c)(iv) and 40 CFR 1502.16). Short-term refers to the time period that includes the immediate implementation of the project and long-term refers to the time period that includes the operation life of the project facilities and beyond. This discussion addresses how the implementation of the action alternatives would affect the long-term productivity of the natural and human environment.

Implementation of the action alternatives would increase the reliability and availability of water supplies within the WWD and WWDD1 service areas in 2008 and 2009. The WA contracts would help WWD and WWDD1 meet current and projected demands, thus supporting the economic viability of the service areas. No short-term effects would occur due to implementation of the action alternatives.

5.3 Irreversible and Irretrievable Commitment of Resources

As stated in Reclamation's NEPA Handbook:

> *"Irreversible commitments are decisions affecting renewable resources such as soils, wetlands, and waterfowl habitat. Such decisions are considered irreversible because their implementation could affect a resource that has deteriorated to the point that renewal can occur only over a long period of time or at great expense or because they would cause the resource to be destroyed or removed."*

The handbook states further:

> *"Irretrievable commitment of natural resources means loss of production or use of resources as a result of a decision. It represents opportunities foregone for the period of time that a resource cannot be used."*

No irreversible commitments of resources associated with implementation of the action alternatives have been identified. PCWA would sign a reservoir refill agreement with Reclamation, ensuring that future refill of any storage space in PCWA's MFP reservoirs created by the transfer would not be with water that PCWA would not otherwise have been entitled to in accordance with its water rights.

5.4 Conflicts With U.S. Bureau of Reclamation Policies

In addition to NEPA compliance, Reclamation must comply with Department of Interior directives such as protection of ITAs and Executive Orders, such as Environmental Justice. Compliance with these directives is discussed below.

5.4.1 Indian Trust Assets

ITAs are legal interests in property held in trust for Indian tribes or individuals by the United States. It is Reclamation's policy to protect ITAs from adverse impacts resulting from its programs and activities. There have been no ITAs identified within the Action Area; therefore, no adverse impacts to ITAs are anticipated as a result of the action alternatives.

5.4.2 Environmental Justice

Executive Order 12898, Environmental Justice, requires that review of proposed Federal actions analyze any disproportionately high and adverse environmental or human health effects on minority and low-income communities. No disproportionately high or adverse environmental or human health impacts on minority or low-income communities have been identified for the action alternatives relative to the No Action Alternative. The action alternatives would have a beneficial effect because the low-income agricultural workers would benefit, because an increased water supply would keep land from being fallowed and would allow them employment.

5.5 Climate Change

Increasing effort is being devoted to studying and evaluating the effects of global climate change on western water resources. On a regional scale, DWR and Reclamation have formed a work team to address water resources related issues of climate change. The mission of the work team is to coordinate with other State and Federal agencies to incorporate climate change science into California's water resources planning and management by providing and regularly updating information to the decision making process on potential risks and impacts of climate change, flexibility of existing facilities to accommodate climate change, and possible mitigation measures (DWR 2008).

These efforts have lead to even more focused studies to identify potential climate change impacts on State and Federal water operations. In 2006, DWR released the first Progress Report titled "Progress on Incorporating Climate Change into Management of California's

Water Resources." Chapter 4 of this Progress Report is entitled "Preliminary Climate Change Impacts Assessment for State Water Project (SWP) and Central Valley Project (CVP) Operations." This analysis provides a preliminary assessment that quantifies impacts for four different scenarios predicted by two global climate models at two carbon dioxide emission rates. The results of this study indicate that *"general shifts in seasonal and annual average runoff … resulted in considerable impacts to SWP and CVP delivery capabilities, especially in the drier scenarios"*.

Given the potential effects to water resources and CVP operations from climate change, this section considers the issue of climate change relative to the action alternatives. This assessment addresses climate change from two perspectives: (1) how the action alternatives may affect global climate change; and (2) how the action alternatives may be affected by climate change.

5.5.1 Effects of Action Alternatives on Global Climate Change

The duration of the action alternatives under consideration is an important component to consider when evaluating how an action may affect global climate change. The action alternatives are the execution of two concurrent short-term WA contracts for conveyance of non-CVP water through Federal facilities. The phrase 'short-term' is used to describe temporary one-year contracts. When considering the duration of the action alternatives in the context of climate change, the length of the proposed contracts is less than the minimum period generally used (i.e., 30 years) to assess climate change (IPCC website 2001).

The scope of the action alternatives is also important to consider when evaluating how an action may affect global climate change. Because no "new water" supplies are being developed, there would be no growth-inducing impacts or land-use changes associated with implementation of the action alternatives. In the context of climate change, there would be no changes in the composition of the atmosphere or in land use associated with the action alternatives.

Because the duration of the action alternatives is less than the minimum period generally used to assess climate changes (i.e., 30 years), and because there are no changes in the composition of the atmosphere or in land use as a result of the action alternatives, there would be no potential impacts on climate change with implementation of the action alternatives.

5.5.2 Effects of Global Climate Change on the Action Alternatives

In order to address how the action alternatives may be affected by climate change, the following discussion summarizes current ideas on how the Sierra Nevada region may be affected by changing climate. In general, a warming climate will result in a greater share of rainfall and a more rapid melt of the snowpack. As such, more runoff will occur in the winter and early spring and less during the late spring and early summer (DWR 2006).

The duration of the action alternatives is also important to consider when evaluating how the action alternatives may be affected by global climate change. Again, the duration of the action alternatives would be less than a year, which is less than the minimum period generally used (i.e., 30 years) to assess climate change (IPCC website 2001).

Because the duration of the action alternatives is less than the minimum period generally used to assess climate changes, there would be no potential impacts resulting from climate change on the action alternatives.

6.0 Consultation and Coordination

6.1 Endangered Species Act (16 USC § 1521 et seq.)

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. To ensure against jeopardy, each Federal agency must consult with USFWS or NMFS, or both, if the Federal agency determines that its action might impact a listed species.

Reclamation has determined the Proposed Action Alternative would have no effect on threatened and endangered species and no further consultation is required under Section 7 of the ESA. This determination is based on the fact that the diversion of this water would only slightly affect reservoir levels and river flows and not change pumping conditions in the Delta to protect fish. The Summer 2009 Action Alternative would have the same effects as those described for the Proposed Action Alternative, except for possible effects to green sturgeon salvage in the Delta during July and August.

The action alternatives would support existing land uses and conditions. Habitat would not be converted or cultivated with action alternatives water. Therefore, the action alternatives would have no effect on federally proposed or listed threatened or endangered species or their proposed or designated critical habitat.

6.2 Magnuson-Stevens Fishery Conservation and Management Act

The 1996 amendments to the MSFCMA (16 USC 1801 et seq.) require the identification of EFH for federally managed fishery species and the implementation of measures to conserve and enhance this habitat. EFH includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity and covers a species' full life cycle (16 USC 1802(10)). Because the action alternatives do not involve construction projects on land or in the water, Reclamation has determined that EFH would not be affected. Consultation is only required if there is an adverse effect.

6.3 Fish and Wildlife Coordination Act (16 USC § 651 et seq.)

The Fish and Wildlife Coordination Act (FWCA) gives the U.S. Secretary of Interior the authority to provide assistance to Federal, State, public, or private agencies in developing, protecting, rearing, or stocking all wildlife, wildlife resources and their habitats. Under the FWCA, whenever waters of any stream or other water body are proposed to be impounded, diverted, or otherwise modified by any public or private agency under Federal permit, that agency must consult with the USFWS and, in California, the CDFG. Because the action alternatives would not involve construction, the FWCA would not apply.

6.4 National Historic Preservation Act (16 U.S.C. § 470 et seq.)

The NHPA requires the Federal government to list significant historic resources in the National Register of Historic Places Federal agencies must consult the National Register when planning to undertake or grant approval for a project. Prior to issuing any license or implementing a project, the Federal agency shall consider the effects of the project or license on any historical buildings, sites, structures, or objects that are included in, or eligible for inclusion in, the National Register. On October 15, 2008, Reclamation determined that the action alternatives are administrative in nature and have no potential to affect historic properties pursuant to the regulations at 36 CFR Part 800.3(a)(1). Due to the nature of the action alternatives, there would be no effect on any historical, archaeological, or cultural resources, and no further compliance actions are required.

6.5 Indian Trust Assets Policy

ITAs are legal interest in property held in trust for Indian tribes or individuals by the United States. Trust Assets can be lands, minerals, hunting and fishing rights, and water rights. Reclamation's ITA policy and NEPA implementing procedures provide for the protection of ITAs from adverse impacts resulting from Federal programs and activities. On October 15, Reclamation determined that the action alternatives do not affect ITAs. The nearest ITA to the action alternatives is the Santa Rosa Rancheria, which is approximately six miles east of Lemoore, California. Due to the nature of the action alternatives, there would be no effect on any ITA, and no further compliance actions are required.

6.6 National Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act of 1968 (P.L.-542, 16 U.S.C. 1271-1287) establishes the policy that certain rivers and their immediate environments which possess outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values will be preserved and protected. In January 1978 and 1981, respectively, the Department of the Interior designated the North Fork American River and the lower American River as wild and scenic for both fishery and recreation values.

Section 10 of this Act requires that each component of the Wild and Scenic river system be administered in such a manner as to protect and enhance the values for which the river was designated. Under this Act, Federal agencies that have discretionary decision-making authority (i.e., permitting authority) must review the proposed project in relation to Section 7 and Section 10 of the Act to determine if the proposed project would affect the values of the Wild and Scenic river. Reclamation would ensure that the action alternatives would not affect the fisheries and recreation values of the North Fork American River and the lower American River.

6.7 Farmland Protection Policy Act, P.L. 97-98

The Farmland Protection Policy Act is administered by the Natural Resources Conservation Service. This act requires a Federal agency to consider the effects of its actions and programs on the Nation's farmlands. The action alternatives would beneficially affect farmland in WWD and WWDD1.

6.8 Other Federal Statutes And Regulations of Relevance

Presented below is a preliminary review of Federal permits and requirements that may be associated with the implementation of the two concurrent proposed short-term WA contracts.

6.8.1 Section 10 of the Rivers and Harbors Act

Under Section 10 of the Rivers and Harbors Act, the Corps regulates the construction of structures or activities that could interfere with navigation. A permit is needed to construct or modify structures such as water intake systems in navigable waters as well as to perform activities such as dredging, stream channelization, excavation, and filling (33 USC § 403). The action alternatives do not involve construction. Therefore, Section 10 of the Rivers and Harbors Act does not apply.

6.8.2 Section 401 of the Clean Water Act

Section 401 of the Clean Water Act (CWA) (33 USC § 1311) prohibits the discharge of any pollutants into navigable waters, except as allowed by permit issued under sections 402 and 404 of the CWA (33 USC § 1342 and 1344). Section 401 requires any applicant for an individual Corps dredge and fill discharge permit to first obtain certification from the state that the activity associated with dredging or filling will comply with applicable state effluent and water quality standards. This certification must be approved or waived prior to the issuance of a permit for dredging and filling. The action alternatives do not involve dredging or filling or the discharge of any pollutants. Therefore, Section 401 of the Clean Water Act does not apply.

6.8.3 Section 404 of the Clean Water Act

Section 404 of the CWA authorizes the Corps to issue permits to regulate the discharge of "dredged or fill materials into waters of the United States" (33 USC § 1344). No activities such as dredging or filling of wetlands or surface waters would be required for implementation of the action alternatives, therefore permits obtained in compliance with CWA section 404 are not required. The action alternatives do not involve dredging or filling. Therefore, Section 404 of the CWA does not apply.

6.8.4 Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 on Protection of Wetlands calls for each Federal agency, in carrying out its ordinary responsibilities, to take actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Reclamation will not be undertaking or assisting in any new construction in wetlands. The action alternatives are in compliance with this executive order.

6.8.5 Executive Order 12898 (Environmental Justice)

Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission, by identifying disproportionately high or adverse human health or environmental effects, including social and economic effects, of its programs and activities on minority populations and low-income communities of the United States. The action alternatives would have a beneficial effect because the low-income agricultural workers would benefit, because an increased water supply would keep land from being fallowed and would allow them employment. Therefore, the action alternatives are in compliance with this executive order.

6.8.6 Executive Order 11988 (Floodplain Management)

Executive Order 11988 on Floodplain Management requires the Corps to provide leadership and take action to: (1) avoid development in the base (100-year) floodplain; (2) reduce the hazards and risks associated with floods; (3) minimize the impact of floods on human safety, health, and welfare; and (4) restore and preserve the natural and beneficial values of the base flood plain. The action alternatives would not affect floodplains, and therefore, are in compliance with this executive order.

7.0 List of Preparers

Table 7-1. List of Preparers

Name	Qualifications	Expertise	Years of Experience	Participation
HDR/SWRI Inc.				
Kirk Rodgers	Environmental Planning	Water Resources	35	Affected Environment, Environmental Consequences
George "Buzz" Link	B.S., Civil Engineering	Hydrologic Modeling and CVP Power	25	Affected Environment, Environmental Consequences
Paul Bratovich	M.S., Fisheries Resources B.S., Fisheries	Fisheries Biology; Endangered Species; Flow-Habitat Relationships	21	Affected Environment, Environmental Consequences
Laurie Warner Herson	Graduate Studies in Near Eastern History and Archaeology B.A., Anthropology	Environmental Planning	31	Other Impact Considerations, QA/QC Review
Michele Stern	Ph.D., Biology M.S., Biology B.S., Biology	Water Resources Environmental Planning	44	Introduction, Description of Proposed Action and Alternatives, Affected Environment, Environmental Consequences
Jelica Arsenijevic	B.S., Earth Systems Science and Policy	Aquatic and Coastal Ecology, Fisheries Biology	6	Affected Environment, Environmental Consequences
LaTisha Burnaugh	M.S., Animal Biology B.S., Animal Science/Management	Terrestrial Biology	4	Affected Environment, Environmental Consequences
U.S. Bureau of Reclamation				
Judi Tapia	B.S., Biochemistry	NEPA Contracts Administration	9 ½ years	Reviewer Reclamation NEPA Team Lead
Valerie Curley	B.S., Architectural Engineering	Planning and Engineering Contract Administration	28 ½ years	Reviewer Contract Repayment Lead
Shauna McDonald	M.S., Biology B.S., Zoology	Biological Resources	6 years	Reviewer Reclamation ESA Team

Table 7-2. List of Preparers (continued)

Name	Qualifications	Expertise	Years of Experience	Participation
Bonnie Van Pelt	M.S., Environmental Science	NEPA Natural Resources Specialist	10 + years	Reviewer-CCAO
Robert Schroeder	B.S., Environmental Resources	Resource Management/ Environmental compliance and Water Contracting	38 years	Review /Comment

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APPENDIX A

SPECIAL-STATUS FISH SPECIES ACCOUNTS

Appendix A
Special-Status Fish Species

A.1 Chinook Salmon

Four principal life history variants are recognized and are named for the timing of their spawning runs: fall-run, late fall-run, winter-run and spring-run (**Table A-1**). The Sacramento River supports all four runs of Chinook salmon. The larger tributaries to the Sacramento River (American, Yuba, and Feather rivers) and rivers in the San Joaquin Basin also provide habitat for one or more of these runs.

Table A-1. Generalized Life History Timing of Central Valley Chinook Salmon Runs

Run	Adult Migration Period	Peak Migration Period	Spawning Period [a]	Peak Spawning Period	Fry Emergence Period	Juvenile Stream Residency	Juvenile Emigration Period
Late fall	Oct – Apr	Dec	Early Jan - Mar	Feb - Mar	Apr - Jun	7-13 months	Apr - Dec
Winter	Dec - Jul	Jan - Mar	Late Apr - Oct	May - Jun	Jul - Oct	5-10 months	Jul - Apr
Spring	Mid-Feb -Jul	Apr - May	Late Aug - Dec	Mid-Sep	Nov - Mar	3-15 months	Oct - Mar
Fall	Jul - Dec	Sep - Oct	Late Sep - Mar	Oct - Nov	Dec - Mar	1-7 months	Dec - Jun

Sources: (Vogel and Marine 1991; CDFG 1998; Moyle 2002; NMFS 2004).

[a] The time periods identified for spawning include the time required for incubation and initial rearing, before emergence of fry from spawning gravels.

Winter-run Chinook Salmon

Winter-run Chinook salmon occur only in the Sacramento River. The Sacramento River winter-run Chinook salmon ESU is listed as “endangered” under both the Federal and State ESA. In 1993, critical habitat for winter-run Chinook salmon was designated to include the Sacramento River from Keswick Dam, (RM [river mile] 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta. Also included are waters west of the Carquinez Bridge, Suisun Bay, San Pablo Bay, and San Francisco Bay north of the San Francisco/Oakland Bay Bridge (NMFS 1993).

Adult winter-run Chinook salmon immigration and holding (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from December through July, with a peak during the period extending from January through April (USFWS 1995a). Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243). Winter-run Chinook salmon spawn between late-April and mid-August, with a peak generally in June. Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October (Vogel and Marine 1991).

Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam occurring from July through March (Reclamation 1992; Vogel and Marine 1991), although NMFS (NMFS 1993; NMFS 1997) report juvenile rearing and outmigration extending from June through April. Emigration (downstream migration) of winter-run Chinook salmon juveniles past Knights Landing, approximately 155.5 RMs downstream of the Red Bluff Diversion Dam, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years (Snider and Titus 2000a; Snider and Titus 2000b). The numbers of juvenile winter-run Chinook salmon caught in rotary screw traps at the Knights Landing sampling location were reportedly dependent on the magnitude of flows during the emigration period (Snider and Titus 2000a; Snider and Titus 2000b). Additional information on the life history and habitat requirements of winter-run Chinook salmon is contained in the NMFS BO for this run (NMFS 1993), which was developed to specifically evaluate impacts on winter-run Chinook salmon associated with CVP and SWP operations.

Spring-run Chinook Salmon

Historically, Central Valley spring-run Chinook salmon occurred in the headwaters of all major river systems in the Central Valley where natural barriers to migration were absent. Beginning in the 1880s, harvest, water development, construction of dams that prevented access to headwater areas and habitat degradation significantly reduced the number and range of spring-run Chinook salmon in the Central Valley. Today, Mill, Deer, and Butte creeks in the Sacramento River system support self-sustaining, persistent populations of spring-run Chinook salmon. The upper Sacramento, Yuba, and Feather rivers also are reported to support spring-run Chinook salmon. Due to the significantly reduced range and small size of remaining spring-run populations, the Central Valley spring-run Chinook salmon ESU is listed as a "threatened" species under both the State ESA and Federal ESA.

Sacramento River spring-run Chinook salmon are known to use the Sacramento River as a migratory corridor to spawning areas in upstream tributaries. Historically, spring-run Chinook salmon did not utilize the mainstem Sacramento River downstream of the Shasta Dam site except as a migratory corridor to and from headwater streams (CDFG 1998). Currently, the extent of spring-run Chinook salmon utilization of the upper Sacramento River (i.e., upstream of the Red Bluff Diversion Dam and downstream of Keswick Dam) for other than a migratory corridor is unclear.

All of the potential spring-run Chinook salmon holding and spawning habitat in the mainstem Sacramento River is located upstream from the Red Bluff Diversion Dam and downstream of Keswick Dam (CDFG 1998). The physical environment downstream from Keswick Dam is adequate for spring-run Chinook salmon; however, in some years high water temperatures would prevent egg and embryo survival (USFWS 1990 as reported *in* CDFG 1998). Water temperature downstream from Keswick Dam is a function of flow releases from Shasta Reservoir, the condition of reservoir storage, depth of water released from the reservoir, and climate. In years of low storage in Shasta Reservoir and under low flow releases, water temperatures exceed 56°F downstream of Keswick Dam during critical months for spring-run Chinook salmon spawning and egg incubation.[1]

[1] A water temperature of 56°F represents the upper value of the water temperature range (i.e., 41.0ºF to 56.0°F) suggested for maximum survival of eggs and yolk-sac larvae in the Central Valley of California (USFWS 1995c).

Adult spring-run Chinook salmon immigration and holding in California's Central Valley Basin occurs from mid-February through September (CDFG 1998; Lindley et al. 2004). Suitable water temperatures for adult upstream migration reportedly range between 57ºF and 67ºF (NMFS 1997). In addition to suitable water temperatures, adequate flows are required to provide migrating adults with olfactory and other cues needed to locate their spawning reaches (CDFG 1998).

The primary characteristic distinguishing spring-run Chinook salmon from the other runs of Chinook salmon is that adult spring-run Chinook salmon hold in areas downstream of spawning grounds during the summer months until their eggs fully develop and become ready for spawning. NMFS (1997) states, "Generally, the maximum temperature for adults holding, while eggs are maturing, is about 59- 60°F, but adults holding at 55-56°F have substantially better egg viability. "Spring-run Chinook salmon reportedly spawn, to some extent, the mainstem Sacramento River. Spawning and embryo incubation has been reported to primarily occur during September through mid-February, with spawning peaking in mid-September (DWR 2004c; DWR 2004d; Moyle 2002; Vogel and Marine 1991). Some portion of an annual year-class may emigrate as post-emergent fry (individuals less than 45 millimeters [mm] in length), and some rear in the upper Sacramento river and tributaries during the winter and spring and emigrate as juveniles (individuals greater than 45 mm in length, but not having undergone smoltification) or smolts (silvery colored fingerlings having undergone the smoltification process in preparation for ocean entry). The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period extending from October through April (Vogel and Marine 1991). On January 2, 2006, NMFS designated the lower American River as critical habitat for non-natal juvenile spring-run Chinook salmon rearing and smolt emigration.

Fall-run Chinook Salmon

In the Central Valley, fall-run Chinook salmon are the most numerous of the four salmon runs, and continue to support commercial and recreational fisheries of significant economic importance. Fall-run Chinook salmon is currently the largest run of Chinook salmon utilizing the Sacramento River system.

Adult fall-run Chinook salmon generally begin migrating upstream annually in July, with immigration continuing through December in most years (NMFS 2004; Vogel and Marine 1991). It has been reported that fall-run Chinook salmon in the Central Valley immigrate into natal rivers as early as June (Moyle 2002). Adult fall-run Chinook salmon immigration generally peaks in November, and typically greater than 90 percent of the run has entered the river by the end of November (CDFG 1992; CDFG 1995).

The timing of adult Chinook salmon spawning activity is strongly influenced by water temperatures. When daily average water temperatures decrease to approximately 60°F, female Chinook salmon begin to construct nests (redds) into which their eggs (simultaneously fertilized by males) are eventually released. Fertilized eggs are subsequently buried with streambed gravel. Due to the timing of adult arrivals and occurrence of appropriate spawning temperatures, spawning activity in recent years in the lower American River, for example, has peaked during mid- to late-November (CDFG 1992; CDFG 1995). In general, the fall-run Chinook salmon spawning and embryo incubation period extends from October through March (NMFS 2004; Vogel and Marine 1991). It should also be noted that if water temperature conditions are sufficiently low (i.e., ≤ 60°F), spawning activity may begin in September (Moyle 2002).

The intra-gravel residence times of incubating eggs and alevins (yolk-sac fry) are highly dependent upon water temperatures. The intra-gravel egg and fry incubation life stage for Chinook salmon generally extends from about mid-October through March.

Within the Action Area, fall-run Chinook salmon fry emergence generally occurs from late-December through March (Moyle 2002). In the Sacramento River Basin, fall-run Chinook salmon juvenile emigration occurs from January through June (Moyle 2002; Vogel and Marine 1991). Emigration surveys conducted by CDFG have shown no evidence that peak emigration of Chinook salmon is related to the onset of peak spring flows in the lower American River (Snider et al. 1997). Temperatures required during emigration are believed to be about the same as those required for successful rearing, as discussed below.

Water temperatures reported to be optimal for rearing of Chinook salmon fry and juveniles are reported to be between 45 and 65°F (NMFS 2002a; Rich 1987; Seymour 1956). Raleigh et al. (1986) reviewed the available literature on Chinook salmon thermal requirements and suggested a suitable rearing temperature range of approximately 53.6 to 64.4°F, and an upper limit of 75°F. Zedonis and Newcomb (1997) report that the smoltification process may become compromised at water temperatures above 62.6°F.

Late Fall-run Chinook Salmon

Most late fall-run Chinook salmon spawn in the Sacramento River, rather than its tributaries (USFWS 1995d). Adult immigration and holding of late fall-run Chinook salmon in the Sacramento River generally begins in October, peaks in December, and ends in April (Moyle 2002). Late fall-run Chinook salmon spawn during periods of high flows, when flow fluctuations can be damaging to redds constructed in high terraces, which can be exposed as water recedes (USFWS 1995d). Spawning in the mainstem Sacramento River occurs primarily from Keswick Dam (RM 302) to Red Bluff Diversion Dam (RM 258), and generally occurs from January through April (Moyle 2002; NMFS 2004; Vogel and Marine 1991). Late fall-run Chinook salmon embryo incubation can extend through June (Vogel and Marine 1991). Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the April through December period (Vogel and Marine 1991).

A.2 Central Valley Steelhead

The Central Valley steelhead DPS is listed as a “threatened” species under the Federal ESA, and has no State listing status. Within the Action Area, Central Valley steelhead occur in the Sacramento and American rivers.

Most wild, indigenous populations of steelhead occur in upper Sacramento River tributaries below the Red Bluff Diversion Dam, including Antelope, Deer, and Mill creeks, and the Yuba River. Remnant populations may also exist in Big Chico and Butte creeks (McEwan and Jackson 1996). Naturally spawning populations also occur in the

American and Feather rivers, and possibly the upper Sacramento and Mokelumne rivers, but these populations have had substantial hatchery influence and their ancestry is not clearly known (Busby et al. 1996). Steelhead runs in the Feather and American rivers are sustained largely by Feather River and Nimbus (American River) hatcheries (McEwan and Jackson 1996).

Estimates of steelhead run sizes have been sporadic and limited to only a few locations over the last 50 years. The average annual run size in the Sacramento River above the mouth of the Feather River during 1953 through 1958 was estimated at 20,540 fish (Hallock 1989). Although an accurate estimate is not available, the recent annual run size for the entire Sacramento River Basin, based on Red Bluff Diversion Dam counts, hatchery counts, and available natural spawning escapement estimates, is probably fewer than 10,000 fish (McEwan and Jackson 1996). The most reliable indicators of recent declines in hatchery and wild stocks are trends reflected in Red Bluff Diversion Dam and hatchery counts. Annual counts at the Red Bluff Diversion Dam declined from an average of 11,187 adult fish in the late 1960s and 1970s to 2,202 adult fish in the 1990s. Recent counts at Coleman, Feather River, and Nimbus hatcheries also are well below the historical averages. Frank Fisher (CDFG) estimated that 10 percent to 30 percent of adults returning to spawn in the Sacramento River system are of hatchery origin (McEwan and Jackson 1996).

Central Valley steelhead is known to use the Sacramento River as a migratory corridor to spawning areas in upstream tributaries. Historically, steelhead likely did not utilize the mainstem Sacramento River downstream from the Shasta Dam site except as a migratory corridor to and from headwater streams. The number of steelhead that spawn in the Sacramento River is unknown, but it is probably low (DWR 2003b).

Adult steelhead immigration into Central Valley streams typically begins in August and continues into March (McEwan 2001; NMFS 2004). Steelhead immigration generally peaks during January and February (Moyle 2002). Optimal immigration and holding temperatures have been reported to range from 46°F to 52°F (CDFG 1991b). Spawning usually begins during late-December and may extend through March, but also can range from November through April (CDFG 1986). Optimal spawning temperatures have been reported to range from 39°F to 52°F (CDFG 1991b). Unlike Chinook salmon, many steelhead do not die after spawning. Those that survive return to the ocean, and may spawn again in future years.

Optimal egg incubation temperatures have been reported to range from 48°F to 52°F (CDFG 1991b). Preferred water temperatures for fry and juvenile steelhead rearing are reported to range from 45°F to 65°F (NMFS 2002a). Each degree increase between 65°F and the upper lethal limit of 75°F reportedly becomes increasingly less suitable and thermally more stressful for the fish (Bovee 1978). Although the reported preferred water temperatures for fry and juvenile steelhead rearing range from 45°F to 65°F, most of the literature on steelhead smoltification suggest water temperatures of 52°F (Adams et al. 1975; Rich 1987;Myrick and Cech 2001), or less than 55°F (Wedemeyer et al. 1980; McCullough et al. 2001; USEPA 2003; Zaugg and Wagner 1973) are required for successful smoltification to occur. The primary period of steelhead smolt emigration occurs from March through June (Castleberry et al. 1991). It has been reported that steelhead move downstream as young-of-the-year (YOY) in the lower American River (Snider and Titus 2000b) from late-spring through summer.

A.3 Green Sturgeon

Green sturgeon migrates from the ocean to freshwater to spawn. Adults of this anadromous fish species tend to be more marine-oriented than the more common white sturgeon. Spawning populations have been identified in the Sacramento River, and most spawning is believed to occur in the upper reaches of the Sacramento River as far north as Red Bluff (Moyle et al. 1995).

Adults begin their inland migration in late-February (Moyle et al. 1995), and enter the Sacramento River between February and late-July (CDFG 2001). Spawning activities occur from March through July, with peak activity believed to occur between April and June (Moyle et al. 1995). Green sturgeon reportedly tolerate spawning water temperatures ranging from 50°F to 70°F (CDFG 2001). Water temperatures above 68°F (20°C) are reportedly lethal to green sturgeon embryos (Beamesderfer and Webb 2002).

Small numbers of juvenile green sturgeon have been captured and identified each year from 1986 through 2001 in the Sacramento River at the Hamilton City Pumping Plant (RM 206) and at Red Bluff Diversion Dam from 1995 through 2001 (NMFS 2002b). Juvenile green sturgeon reportedly rear in their natal streams year-round (Environmental Protection Information Center et al. 2001; Moyle 2002). Growth of juvenile green sturgeon is reportedly optimal at 59°F (15°C) and reduced at both 51.8°F (11°C) and 66.2°F (19°C) (Cech et al. 2000). Proposed critical habitat designation for the southern Distinct Population Segment (DPS) of North American Green Sturgeon was noticed in the Federal Register on September 8, 2008 (73 FR 52084). The southern DPS consists of populations originating from coastal watersheds south of the Eel River (“Southern DPS”). The only known spawning population for the Southern DPS is in the Sacramento River.

A.4 American Shad

American shad occur in the Sacramento River, its major tributaries, the San Joaquin River and the Delta. Because of its importance as a sport fish, American shad have been the subject of investigations by CDFG. American shad are native to the Atlantic coast and were planted in the Sacramento River in 1871 and 1881 (Moyle 2002).

Adult American shad typically enter Central Valley rivers from April through early July (CDFG 1986), with the majority of immigration and spawning occurring from mid-May through June (Urquhart 1987). Water temperature is an important factor influencing the timing of spawning. American shad are reported to spawn at water temperatures ranging from approximately 46°F to 79°F (USFWS 1967), although optimal spawning temperatures are reported to range from about 60ºF to 70°F (Bell 1986; CDFG 1980; Leggett and Whitney 1972; Painter et al. 1979; Rich 1987). Spawning takes place mostly in the main channels of rivers, and generally about 70 percent of the spawning run is made up of first time spawners (Moyle 2002).

Shad have remarkable abilities to navigate and to detect minor changes in their environment (Leggett 1973). Although homing is generally assumed in the Sacramento

River and its tributaries, there is some evidence that numbers of first-time spawning (i.e., "virgin") fish are proportional to flows of each river at the time the shad arrive. When suitable spawning conditions are found, American shad school and broadcast their eggs throughout the water column. The optimal temperature for egg development is reported to occur at 62°F. At this temperature, eggs hatch in six to eight days; at temperatures near 75°F, eggs would hatch in three days (MacKenzie et al. 1985). Egg incubation and hatching, therefore, are coincident with the spawning period.

A.5 Striped Bass

Striped bass occur in the Sacramento River, its major tributaries, and the Delta. Substantial striped bass spawning and rearing occurs in the Sacramento River and Delta, although striped bass can typically be found upstream as far as barrier dams (Moyle 2002). Striped bass are native to the Atlantic coast. They were first introduced to the Pacific coast in 1879, when they were planted in the San Francisco Estuary (Moyle 2002).

Adult striped bass are present in Central Valley rivers throughout the year, with peak abundance occurring during the spring months (CDFG 1971; DeHaven 1979; DeHaven 1977). Striped bass spawn in water temperatures ranging from 59°F to 68°F (Moyle 2002). Therefore, spawning may begin in April, but peaks in May and early-June (Moyle 2002). In the Sacramento River, most striped bass spawning is believed to occur between Colusa and the mouth of the Feather River. In years of higher flow, spawning typically occurs further upstream than usual because striped bass continue migrating upstream while waiting for temperatures to rise (Moyle 2002). Sacramento River currents carry striped bass embryos and larvae to rearing habitats in the Delta.

The number of striped bass entering Central Valley streams during the summer is believed to vary with flow levels and food production (CDFG 1986). Sacramento River tributaries seem to be nursery areas for young striped bass (CDFG 1971; CDFG 1986). Optimal water temperatures for juvenile striped bass rearing have been reported to range from approximately 61°F to 73°F (USFWS 1988).

A.6 Delta Smelt

In addition to the Delta, delta smelt have been found in the Sacramento River as far upstream as the confluence with the American River (Moyle 2002; USFWS 1994).

Delta smelt are a euryhaline fish, native to the Sacramento-San Joaquin estuary. As a euryhaline species, delta smelt tolerate wide-ranging salinities, but rarely occur in waters with salinities greater than 10 ppt to 14 ppt (Baxter et al. 1999). Similarly, delta smelt tolerate a wide-range of water temperatures, as they have been found at water temperatures ranging from 42.8°F to 82.4°F (Moyle 2002). Delta smelt are typically found within Suisun Bay and the lower reaches of the Sacramento and San Joaquin rivers, although they are occasionally collected within the Carquinez Strait and San Pablo Bay. The delta smelt is a small slender bodied fish, with a typical adult size of 2 to 3 inches, although some individuals may reach lengths of 5 inches.

During the late winter and spring, delta smelt migrate upstream into freshwater areas to spawn. Shortly before spawning, adults migrate upstream from the brackish-water estuarine areas into river channels and tidally influenced backwater sloughs. In the Sacramento-San Joaquin river system, delta smelt spawning reportedly occurs from February through May, with embryo incubation extending through June (Wang 1986). Delta smelt are thought to spawn in shallow fresh or slightly brackish waters in tidally influenced backwater sloughs and channel edgewaters (Wang 1986). While most delta smelt spawning seems to take place at 44.6°F to 59°F, gravid delta smelt and recently hatched larvae have been collected at 59°F to 71.6°F. Thus, it is likely that spawning can take place over the entire range of 44.6°F to 71.6°F (Moyle 2002). Females generally produce between 1,000 and 2,600 eggs (Bennett 2005), which adhere to vegetation and other hard substrates. Larvae hatch in between 10 and 14 days (Wang 1986) and are planktonic (float with water currents) as they are transported and dispersed downstream into the low-salinity areas within the western delta and Suisun Bay (Moyle 2002). Delta smelt grow rapidly, with the majority of smelt living only one year. Most adult smelt die after spawning in the early spring; although they may be capable of spawning twice during a season, (Bennett 2005; Brown and Kimmerer 2001; Moyle 2002). Delta smelt feed entirely on zooplankton. For the majority of their one-year life span, delta smelt inhabit areas within the western Delta and Suisun Bay characterized by salinities of approximately 2 ppt. Historically, they have been abundant in low (around 2 ppt) salinity habitats. Delta smelt occur in open surface waters and shoal areas (USFWS 1994).

Because delta smelt typically have a one-year life span, their abundance and distribution have been observed to fluctuate substantially within and among years. Delta smelt abundance appears to be reduced during years characterized by either unusually dry years with exceptionally low outflows (e.g. 1987 through 1991) and unusually wet years with exceptionally high outflows (e.g. 1982 and 1986). Other factors thought to affect the abundance and distribution of delta smelt within the Bay-Delta estuary include entrainment in water diversions, changes in the zooplankton community resulting from introductions of non-native species, and potential effects of toxins.

A.7 Sacramento Splittail

USFWS removed Sacramento splittail from the list of threatened species on September 22, 2003, and did not identify it as a candidate for listing under the ESA. Sacramento splittail are however, identified as a California species of special concern and, informally, as a Federal species of concern. Splittail occur in the Sacramento River, its major tributaries, the San Joaquin River and the Delta.

Sacramento splittail spawning can occur anytime between late February and early July but peak spawning occurs in March and April (Moyle 2002). DWR (2004a) reported that Sacramento splittail spawning, egg incubation and initial rearing in the Feather River primarily occurs during February through May. Attraction flows are necessary to initiate travel onto floodplains where spawning occurs (Moyle et al. 2004). Spawning generally occurs in water with depths of three to six feet over submerged vegetation where eggs adhere to vegetation or debris until hatching (Moyle 2002; Wang 1986). Eggs normally incubate for three to seven days depending on water temperature (Moyle 2002). After hatching, splittail larvae remain in shallow weedy areas until water recedes, and they migrate downstream (Meng and Moyle 1995).

Juvenile Sacramento splittail prefer shallow-water habitat with emergent vegetation during rearing (Meng and Moyle 1995). Sommer et al. (Sommer et al. 2002) reports juvenile splittail are more abundant in the Yolo Bypass floodplain in the shallowest areas of the wetland with emergent vegetation. Downstream movement of juvenile splittail appears to coincide with drainage from the floodplains between May and July (Caywood 1974; Meng and Moyle 1995; Sommer et al. 1997).

Sommer et al. (1997) discuss the resiliency of splittail populations and suggest that because of their relatively long life span, high reproductive capacity and broad environmental tolerances, splittail populations have the ability to recover rapidly even after several years of drought conditions. This suggests that frequent floodplain inundations are not necessary to support a healthy population. Moyle et al. (2004) report that the ability of at least a few splittail to reproduce even under the worst flow conditions insures that the population will persist indefinitely, despite downward trends in total population size during periods of drought.

A.8 Hardhead

Hardhead are a large (occasionally exceeding 600 mm standard length [SL]), native cyprinid species that generally occur in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 2002). The species is widely distributed throughout the Sacramento-San Joaquin River system, though it is absent from the valley reaches of the San Joaquin River. Hardhead mature following their second year. Spawning migrations, which occur in the spring into smaller tributary streams, are common. The spawning season may extend into August in the foothill streams of the Sacramento and San Joaquin River basins. Spawning behavior has not been documented, but hardhead are believed to elicit mass spawning in gravel riffles (Moyle 2002). Little is known about life stage specific temperature requirements of hardhead; however, temperatures ranging from approximately 65°F to 75°F are believed to be suitable (Cech et al. 1990).

A.9 Longfin Smelt

Longfin smelt is a euryhaline species. They are most abundant in San Pablo and Suisun bays (Moyle 2002). They tend to inhabit the middle to lower portion of the water column. The longfin smelt spends the early summer in San Pablo and San Francisco bays, generally moving into Suisun Bay in August. Most spawning is from February to April at water temperatures of 44.6°F to 58.1°F (Moyle 2002). The majority of adults perish following spawning. Longfin smelt eggs have adhesive properties and are probably deposited on rocks or aquatic plants upon fertilization. Newly hatched longfin smelt are swept downstream into more brackish parts of the estuary. Strong Delta outflow is thought to correspond with longfin smelt survival, as higher flows transport longfin smelt young to more suitable rearing habitat in Suisun and San Pablo bays (Moyle 2002). Longfin smelt are rarely observed upstream of Rio Vista in the Delta (Moyle et al. 1995).

A.10 River Lamprey

The anadromous river lamprey is found in coastal streams from San Francisco Bay to Alaska (Moyle 2002). Adults migrate back into freshwater in the fall and spawn from April to June in small tributary streams (Wang 1986). River lamprey are reported to spawn at water temperatures ranging from 55.4°F to 56.3°F (Wang 1986). Adults die after spawning. Presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocoetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and water temperatures do not exceed 77°F. Ammocoetes begin their transformation into adults when they are about 12 cm TL, during the summer. The process of metamorphosis may take nine to 10 months, the longest known for any lamprey species. Lampreys in the final stages of metamorphosis congregate immediately upriver from saltwater and enter the ocean in late spring. Adults apparently only spend three to four months in saltwater, where they grow rapidly, reaching 25 cm to 31 cm TL (Moyle 2002).

A.11 Sacramento Perch

Sacramento perch are deep-bodied, laterally compressed centrarchids. Historically, Sacramento perch were found throughout the Central Valley, the Pajaro and Salinas rivers, and Clear Lake. The only populations today that represent continuous habitation within their native range are those in Clear Lake and Alameda Creek. Within their native range, Sacramento perch exist primarily in farm ponds, reservoirs, and lakes into which they have been introduced (Moyle 2002). Sacramento perch are often associated with beds of rooted, submerged, and emergent vegetation and other submerged objects. Sacramento perch are able to tolerate a wide range of physicochemical water conditions. This tolerance is thought to be an adaptation to fluctuating environmental conditions resulting from floods and droughts. Thus, Sacramento perch do well in highly alkaline water (McCarraher and Gregory 1970; Moyle 1976). Most populations today are established in warm, turbid, moderately alkaline reservoirs or farm ponds. Spawning occurs during spring and early summer and usually begins by the end of March, continuing through the first week of August (Mathews 1965; Moyle 2002). Introductions of non-native species, not necessarily habitat alterations, are foremost in the cause of Sacramento perch declines (Moyle 2002).

A.12 California Roach

The California roach, a native freshwater minnow, is found throughout the Sacramento-San Joaquin Basin (Moyle 2002). California roach are generally found in small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al. 1982; Moyle 2002). They are most abundant in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams (Moyle 2002). Roach are tolerant of relatively high temperatures (86°F to 95°F) and low oxygen levels (1 to 2 parts per million [ppm]) (Taylor et al. 1982). Roach reach sexual maturity by about the second year (approximately 45 mm SL). Reproduction generally occurs from March to June, usually when temperatures exceed 60.8°F, but may be extended through late July (Moyle 2002).

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APPENDIX B

SPECIAL-STATUS TERRESTRIAL SPECIES ACCOUNTS

Appendix B
Special-Status Terrestrial Species

B.1 Valley Elderberry Longhorn Beetle *(Desmocerus californicus dimorphus)*

The valley elderberry longhorn beetle (VELB) is completely dependent on its host plant, elderberry (*Sambucus mexicana*), in California's Central Valley and associated foothills during its entire life cycle. VELB larvae live within the soft pith of the elderberry where they feed for one to two years. Adults emerge from pupation inside the wood of elderberry shrubs during the spring as the plant begins to flower. The adults feed on the elderberry foliage up until they mate. Females lay their eggs in the crevices of elderberry bark. Upon hatching the larvae then tunnel into shrub stems and feed there. VELB typically utilize stems that are greater than one-inch in diameter at ground level. Due largely to the loss of riparian habitat within California's Central Valley, the VELB populations in the state had decreased to a point that in 1980 the USFWS listed the species as threatened pursuant to the Federal Endangered Species Act. In October 2006, the USFWS recommended removal of VELB from the endangered species list, due to successful restoration and protection of VELB habitat and a slow in the decline in riparian habitat (USFWS 2007a). However, as of the date of this report, VELB is still listed as threatened by the USFWS.

Portions of the Action Area occur within critical habitat for the VELB. Critical habitat occurs on the south bank of portions of the American River within the American River Parkway Zone (USFWS 2007a). Several occurrences of VELB have been recorded within this zone and within riparian areas along Folsom Reservoir and other water bodies within the Action Area.

B.2 Shasta Crayfish *(Pacifastacus fortis)*

Shasta crayfish are one to two inches in length and vary in color from dark brownish green to dark brown. This species is very limited in distribution and occupies only cool, clear, spring-fed lakes, rivers, and streams with volcanic rubble substrate. Shasta crayfish mate in October and November and females hatch 10 to 70 eggs in the spring. While nutritional requirements of this species are largely unknown, primary food sources are likely periphyton and small invertebrates such as snails. The Shasta crayfish is found only in Shasta County, in the Pit River drainage and two tributaries, Fall River and Hat Creek drainages (USFWS 2007c).

The Shasta crayfish was listed as endangered in 1988. Critical habitat has not been designated for this species. A recovery plan for the Shasta crayfish was finalized in August 1988. The Recovery Plan for the Shasta Crayfish outlines historic and current distributions, species requirements, and recovery goals (USFWS 1998).

While potential habitat for this species may occur within the inflow areas to Shasta Reservoir, occurrence of this species is unlikely due to limited distribution. While the Pit

River flows into Shasta Reservoir from the east, the closest occurrence of the Shasta crayfish is in the Pit River at the Pit River hatchery and Pit River Falls, over 30 miles northeast of Shasta Reservoir.

B.3 California Red-legged Frog *(Rana aurora draytonii)*

California red-legged frog (CRLF) occurs from Baja California, Mexico, north to the vicinity of Redding inland, and at least to Point Reyes, California coastally. CRLF is primarily an aquatic species, though it may use some upland habitat during the non-breeding season. Aquatic habitat consists of low-gradient freshwater bodies, including ponds, marshes, lagoons, seeps, springs, and backwaters within streams and creeks. While CRLF can occur in either ephemeral or perennial streams or ponds, populations generally cannot be maintained in ephemeral streams in which surface water disappears before metamorphosis (July to September) during most years. Adults seek out waters with dense shoreline vegetation such as willows (*Salix* spp.) and cattails (*Typha* spp.). During the non-breeding season, frogs may use upland habitat that provides shade, moisture, and cooler temperatures, such as spaces under boulders and organic debris. CRLF may use these upland habitats up to approximately 200 feet from suitable aquatic habitat (USFWS 2002; USFWS 2007b).

CRLF typically lay eggs between December and early April. Eggs are attached to vegetation in shallow water. Tadpoles develop into terrestrial frogs between July and September. Breeding ponds must retain water until this time. CRLF may remain active throughout the year along the coast. In drier inland areas they aestivate in upland habitat from late summer to early winter (USFWS 2002; USFWS 2007b).

USFWS designated eight recovery units in the “Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*)” (USFWS 2002). Portions of the action area occur in Recovery Units 1, 2, 4, and 6. The portion of the action area that comprises the junction of the Sacramento and San Joaquin Rivers is within a Core area as designated by the Recovery Plan. San Luis Reservoir is also within a Core area for CRLF. In September 2008 the USFWS proposed to increase the area covered by the Recovery Plan.

Several occurrences of CRLF have been recorded in the vicinity of the action area, including occurrences near the Delta Mendota Canal and near Highway 152, in the vicinity of the San Luis Reservoir. Reservoirs and other slow moving aquatic areas within the action area, particularly habitats associated with the San Luis Reservoir and areas within the vicinity of the Delta, may provide habitat for the CRLF.

B.4 Mountain Yellow-legged Frog *(Rana muscosa)*

The mountain yellow-legged frog inhabits lakes, meadow streams, isolated pools, and sunny riverbanks. The mountain yellow-legged frog is found at elevations ranging from 984 feet to over 12,000 feet. This species is distributed from the Sierra Nevada Mountains from north of the Feather River in Butte County, to Tulare County, and in isolated locations in the San Gabriel, San Bernardino, and San Jacinto mountains, and on Mt. Palomar. Additionally, this species may be found outside of California in Nevada around the Lake Tahoe area.

The mountain yellow-legged frog ranges in size from 1.5-3.5 inches and is variable in color: olive, yellowish or brown above, with varying amounts of black or brown markings, and pale orange to yellow below and underneath the hind legs. This species smells like garlic when handled. The mountain yellow-legged frog emerges from hibernation shortly after snow melts. It is usually found close to water, and rarely occurs where predatory fish have been introduced. The diet of this species includes a variety of terrestrial and aquatic invertebrates and tadpoles. The tadpoles of this species are slow to mature and may take as many as two to four summers to transform (USFWS 2007d).

The Sierra Nevada population is a candidate for Federal listing. The Sierra Nevada population was proposed for listing in January 2003. The USFWS determined that listing for this species is warranted, but precluded by higher priority actions (USFWS 2007d). The mountain yellow-legged frog has the potential to occur in reservoirs and streams associated with the northern portion of the Action Area.

B.5 Giant Garter Snake *(Thamnophis gigas)*

The giant garter snake can reach lengths of up to five feet. The dorsal side is brownish with a checkered pattern of black spots separated by a yellow dorsal stripe and two paler lateral stripes. Ventral coloration is cream to olive color. Mating occurs in March and April with a clutch size of 10 to 46. This species can inhabit agricultural wetlands and other waterways such as irrigation and drainage canals, sloughs, ponds, small lakes, low gradient streams, and adjacent uplands. Giant garter snakes require adequate water during their active season (early spring through mid-fall) to provide food and cover; emergent, herbaceous wetland vegetation for foraging and cover. They also require grassy banks and openings in waterside vegetation for basking and higher elevation uplands for cover and refuge from flood waters during its dormant season (winter). This species inhabits small mammal burrows and other soil crevices with sunny exposure along south and west facing slopes, above prevailing flood elevations when dormant (USFWS 2007e).

The historic distribution of this species is from the Sacramento and San Joaquin Valleys as far north as Butte County down to Kern County. The active period ranges from March to October. The giant garter snake relies on small fish, tadpoles and frogs as a primary diet and hunts primarily during morning and evening hours. Nighttime hours are spent in mammal burrows for cover and refuge (USFWS 2007e).

Critical habitat has not been designated for the giant garter snake; however the historical range for this species extends through most of Central California. Portions of the Action Area are within the historical range of this species.

B.6 Western Yellow-billed Cuckoo *(Coccyzus americanus occidentalis)*

Western yellow-billed cuckoos inhabit deciduous riparian thickets or forests with thick understory vegetation, contiguous with slow-moving waterways. Willows and cottonwoods tend to be dominant species of the known habitat. Prey base consists of large insects and occasionally frogs or lizards. This species lays a clutch of two to three eggs and the young develop rapidly. However they require large sections (a minimum of 25 acres) of riparian land for breeding habitat. Once widespread and common throughout the lowlands of California, this species' numbers have been drastically reduced by the loss of riparian habitat due to conversion for agricultural lands, dams, and urban uses, livestock grazing, and the introduction of invasive species (USFWS 2007f).

The western yellow-billed cuckoo was proposed for listing in July 2001. The USFWS determined that listing for this species is warranted, but precluded by higher priority actions (USFWS 2007f). Riparian corridors along the rivers and reservoirs within the action area provide potential habitat for the western yellow-billed cuckoo.

B.7 American Peregrine Falcon *(Falco peregrinus anatum)*

Nesting habitat for this species consists of vertical rocky cliffs in undisturbed areas, and tall buildings, bridges, rock quarries, and raised platforms in man-made sites. Foraging habitat for this species consists of open areas such as grassland, pasture, or rivers. Their prey is generally medium sized passerines as well as small waterfowl. Some small mammals as well as invertebrates also contribute to their diet.

The American peregrine falcon was listed in 1970 as threatened pursuant to the Federal Endangered Species Act, due to a decline in species numbers. In August 1999 this species was de-listed as recovery efforts had been successful. A monitoring plan was released by the USFWS in 2003 to monitor the success and location of the species (USFWS 2008b). Bridges, dam structures and areas with steep topography along Shasta Reservoir may provide potential nesting habitat for the American peregrine falcon.

B.8 Bald Eagle *(Haliaeetus leucocephalus)*

Bald eagles typically are found near open water (e.g., reservoirs, lakes, and rivers) and often use these habitats to forage on resident and anadromous fish species. Such areas require an adequate food base, perching areas, and nesting sites to support bald eagles. Large, dead trees near open water typically are used for perching and are an important habitat component. During winter bald eagles often congregate at specific wintering sites that generally are close to open water and that offer good perch trees and night roosts. Bald eagles have been observed at and around Folsom Reservoir during the winter season, although generally in low numbers. Fish are the primary prey type, although bald eagles also take small mammals, birds, and carrion.

A nesting pair of bald eagles was observed in the Anderson Island Natural Preserve near Folsom Reservoir as recent as June 2008. Several occurrences of nesting bald eagles have been recorded in CNDDB along Shasta Reservoir over a number of years. Reservoirs and rivers within the action area provide potential foraging habitat for this species.

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